Air Quality
CONSULTANTS

Air Quality Input for Habitats Regulations Assessment:

New Forest

April 2018

Experts in air quality
management & assessment

Document Control

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Job Number	J2999

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Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J2999/A/1/F3	12 April 2018	Final	Prof. Duncan Laxen (Managing Director)

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Contents

1 Introduction

1.1 This report provides information to inform the Habitats Regulation Assessment of the New Forest and the New Forest National Park Authority Local Plans regarding the potential for adverse air quality impacts on European designated ecological sites within the district of New Forest Council and the New Forest National Park Authority. The assessment is intended to assist New Forest District Council and the New Forest National Park Authority in meeting its Habitats Regulations duty as relevant to plan making and in particular the New Forest and New Forest National Park Authority Local Plans.

1.2 The ecological sites considered within this assessment are:

- New Forest Special Area of Conservation (SAC);
- New Forest Special Protection Area (SPA);
- New Forest Ramsar;
- Solent Maritime SAC;
- Solent and Southampton Water SPA;
- Solent and Southampton Water Ramsar;
- Dorset Heaths SAC;
- Dorset Heathlands SPA; and
- Dorset Heathlands Ramsar.

1.3 The New Forest is designated as a SAC, SPA and Ramsar site. The area is considered to be important due to the relatively large areas of lowland habitats which still remain, including valley bogs, wet heaths and deciduous woodland. The wet heaths are important for rare plants, such as Gentiana pneumonanth (marsh gentian) and Lycopodiella inundata (marsh clubmoss), with the forest bogs providing a habitat for the rare Hammarbya paludosa (bog orchid). In addition, the Forest is home to the New Forest Cicada, the only cicada native to Britain.

1.4 The Solent, designated as a SAC, SPA and Ramsar site, is recognised for complex marine and estuarine habitats, including extensive estuarine flats supporting eelgrass and green algae. The Solent is also the only site for smooth cord-grass, and contains the second largest aggregation of Atlantic salt meadows in the south and south-west England.

1.5 The Dorset Heaths, of which a small section crosses into the western boundary of New Forest district, is designated as a SAC, SPA and Ramsar site. The Heaths are recognised for dry heaths and wet lowland heathland, as well as woodland, saltmarsh and reedswamp. The wet heaths are known for Molinia caerulea (purple moor-grass), Calluna vulgaris (heather) and Erica tetralix (cross-leaved heath), as well as invertebrates such as dragonflies, damselflies and spiders, some of which are restricted to solely the Dorset heaths.

1.6 Two future assessment years have been considered within this report; 2026 and 2036, following the proposed Local Plan land allocations of both New Forest District Council and the New Forest National Park Authority. The quantum of Local Plan development for 2026 is determined based on the trajectory supplied by the New Forest District Council, with 2036 completing the plan period, and thus containing all planned land allocations. The approximate total supply of housing delivered during the plan period is 10,500 – 13,000, with an estimated 60 – 65% delivered by 2026.

1.7 As part of the Habitat Regulations Assessment for the New Forest Local Plan, New Forest District Council has identified that an increase in traffic related to development proposed within the Plan may have a significant effect on the designated ecological sites outlined in Paragraph 1.2 and thus, under the Habitats Regulations, the Council requires further information to inform its Habitats Regulations Assessment. The main air pollutants of concern related to traffic emissions, and the potential for adverse effects on the designated ecological sites, are nitrogen oxides (NOx), nutrient nitrogen deposition, acid deposition and ammonia.

1.8 This assessment has been carried out by Air Quality Consultants Ltd on behalf of New Forest District Council and the New Forest National Park Authority. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A1.

2 Policy Context and Assessment Criteria

Relevant Policies

2.1 The “Habitats Directive” (European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992) requires member states to introduce a range of measures for the protection of habitats and species. The Regulations (The Conservation of Habitats and Species Regulations 2010 Statutory Instrument 490, 2010), transpose the Directive into law in England and Wales. They require the Secretary of State to provide the European Commission with a list of sites which are important for the habitats or species listed in the Directive. The Commission then designates worthy sites as Special Areas of Conservation (SACs). The Regulations also require the compilation and maintenance of a register of European sites, to include SACs and Special Protection Areas (SPAs), with the latter classified under the “Birds Directive” (Directive 2009/147/EC of the European Parliament and of the Council, 2009). These sites form a network termed “Natura 2000”.

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

2.3 In addition to SACs and SPAs, some internationally important UK sites are designated under the Ramsar Convention. Originally intended to protect waterfowl habitat, the Convention has broadened its scope to cover all aspects of wetland conservation. Planning policy requires that Ramsar Sites are treated in an equivalent manner to European sites.

2.4 The Habitats Directive (as implemented by the Regulations) requires the competent authority, which in this case will be the planning authority, to firstly evaluate whether the development is likely to give rise to a significant effect on the European site. Where this is the case, it has to carry out an Appropriate Assessment in order to determine whether the development will adversely affect the integrity of the site.

Assessment Criteria

2.5 Critical levels and critical loads are the ambient concentrations and deposition fluxes below which significant harmful effects to sensitive ecosystems are unlikely to occur. Typically, the potential for exceedances of the critical levels and critical loads is considered in the context of the level of protection afforded to the ecological site as a whole. For example, the level of protection afforded to an internationally-designated site (such as a Ramsar, SAC or SPA) is significantly greater than that afforded to a local nature reserve; reflecting the relative sensitivity of the sites as well as their perceived ecological value. The critical levels relevant to this assessment are set out in Table 1, while the critical loads are provided in Table 2.

2.6 Each receptor has been assigned a broad habitat, and, where possible, a priority habitat, established using maps provided by the Hampshire Biodiversity Information Centre. Priority habitats are those that have been identified as being the most threatened and requiring conservation action, whilst the broad habitats were developed to understand how the priority habitats are set within the context of the UK. The critical loads have then been defined from APIS, using the broad or priority habitat classification. Where a receptor can be assigned a critical load from both the broad and priority habitat classification, the minimum critical load has been used.

Table 1: Vegetation and Ecosystem Critical Levels [a]

Pollutant	Time Period	Critical Level
NOx (expressed as NO_2)	Annual Mean [a, b]	30 µg/m^3
	24-Hour Mean [a]	75 µg/m^3
Ammonia	Annual Mean	1 µg/m^3 [c]

[a] The critical levels are defined by the World Health Organisation (WHO, 2000). Ammonia critical level is defined by the Convention on Long-Range Transboundary Air Pollution (CLRTAP)

[b] Away from major sources (see Paragraph 2.7), this critical level is set as an objective by the UK Government (Defra, 2007) and a limit value by the European Union (Directive 2008/50/EC of the European Parliament and of the Council, 2008).

[c] A critical level of 1 µg/m^3 has been used for this assessment (rather than 3 µgm^3) following advice from the Centre for Ecology and Hydrology on projects with similar habitats.

Table 2: Vegetation and Ecosystem Critical Loads

Habitat Type	Nutrient Nitrogen (kgN/ha/yr) [a]
Broad Habitat Classifications	
Acid Grassland	10
Bracken	10
Broadleaved Woodland	10
Calcareous Grassland	15
Coniferous Woodland	10
Dwarf Shrub Heath	10
Fen Marsh	10
Improved Grassland	15
Littoral Sediment	20
Neutral Grassland	20
Supralittoral Sediment	8
Priority Habitat Classifications	
Coastal Saltmarsh	20
Coastal Vegetated Shingle	8

Habitat Type	Nutrient Nitrogen (kgN/ha/yr) [a]
Intertidal Mudflats	20
Lowland Dry Acid Grassland	10
Lowland Beech and Yew	10
Lowland Fens	15
Lowland Heathland	10
Lowland Meadows	20
Lowland Mixed Deciduous	10
Purple Moor Grass	15
Reedbeds	15
Wet Woodland	10
Wood Pasture and Parkland	10

[a] Critical loads for nutrient nitrogen taken from the Air Pollution Information System (APIS) website (APIS, 2017). For grassland habitats, namely acid, neutral and calcareous, critical loads are available for both alpine and subalpine and non-Mediterranean locations; for the purposes of this assessment, alpine and subalpine environments were not considered appropriate. Bracken and fen marsh were treated as dry heathland, whilst arctic and alpine conditions were not considered appropriate for dwarf shrub heath. The critical load for mid-upper saltmarshes was used for littoral sediment, with the recommended value for acid dunes used for supralittoral sediment habitats.

2.7 Habitat maps were not provided for the Dorset Heaths and Solent designated areas. Following advice from BSG Ecology, a nutrient nitrogen critical load of 20 kgN/ha/yr has been used for the Solent, and a value of 10 kgN/ha/yr has been used for the Dorset Heaths. These values are considered appropriate as they are the minimum values provided for the most sensitive habitats within the respective area.

2.8 The critical loads for nutrient nitrogen deposition are at least as stringent as those for acid nitrogen deposition (i.e. the critical load for acid deposition could not be exceeded unless the critical load for nutrient nitrogen deposition was also exceeded). This study has, therefore, focused on nutrient nitrogen deposition and not presented results for acid deposition. The results can be provided if further analysis undertaken by BSG Ecology identifies a particular sensitivity to acid deposition.

2.9 Objectives for the protection of vegetation and ecosystems have also been set by the UK Government and have the same numerical values as the critical levels that have been used in this assessment. The objectives, however, 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[1]. The objectives will therefore not strictly apply in the Lymington and Totton areas, where Census information indicates populations of greater than 5,000.

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[1] The same concentrations, with the same constraints, have also been set as Limit Values by the European Commission.

Descriptors for Air Quality Impacts and Assessment of Significance

2.10 The Environment Agency's Air Emissions Risk Assessment guidance (Environment Agency, 2016) discounts as insignificant any impact on a national or European designated ecological site from an individual permit[2] application if the change in annual mean concentration or deposition flux is <1% of a long-term (e.g. annual mean) or 10% of a short-term (e.g. 24-hour mean) environmental standard. This is the case regardless of the existing or predicted future baseline level (i.e. whether or not the critical level or critical load is currently exceeded). The Environment Agency does not suggest that impacts will necessarily be significant above these criteria, merely that there is a potential for significant impacts to occur that should be considered using alternative means. When issuing permits to operate, the Environment Agency also suggests that there is no need for additional assessment if it can be demonstrated that the predicted concentration or flux (with the proposed operation in place) is less than the critical level or critical load.

2.11 Despite their origin, these criteria are commonly used as screening criteria when assessing all manner of development schemes, including those that generate road traffic. Because many interested parties are familiar with these screening criteria, they have been used here as one of the ways to present the results. It is not within the scope of this section to appraise whether or not the Environment Agency screening criteria provide an appropriate level of assessment, or protection, with respect to traffic-related impacts from a Local Plan.

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[2] The Environment Agency issues permits to operate industrial processes in England and Wales and its guidance was developed for this purpose.

3 Assessment Approach

Existing Conditions

3.1 Background concentrations across the study area have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid. 2015 has been used as the base year, with 2026 and 2036 as future years. Since the background maps only predict up to 2030, the values for 2030 have been used for 2036. Background nitrogen deposition fluxes and ammonia concentrations across the ecological areas have been provided by the Centre for Ecology and Hydrology and cover the country on a 5x5 km grid. The latest available year of 2014 has been used as the base year, and factored forward to 2026 and 2036 (see Paragraph 3.8, Paragraph 3.9 and Appendix A2 for further information).

Road Traffic Impacts

3.2 Pollutant concentrations have been modelled over a series of transects, covering up to 2,560 m from the edge of major roads passing through the ecological areas, including the A31, A35, A337 and B3078. The modelled transects are shown in Figure 1. Concentrations have been modelled at 1, 2, 3, 4, 5, 7, 9, 11, 13, 15 and 20 m for approximately 550 transect locations. At approximately 200 of these locations, the transects have been extended to cover distances of 40, 80, 160, 320, 640, 1,280 and 2,560 m from the roadside.

3.3 Concentrations have also been modelled at 21 diffusion tubes located within Lyndhurst, as well as at three other locations adjacent to roads representative of roads passing through the ecological areas, in order to verify the modelled results (see Appendix A2 for verification method). The diffusion tubes are operated by New Forest District Council.

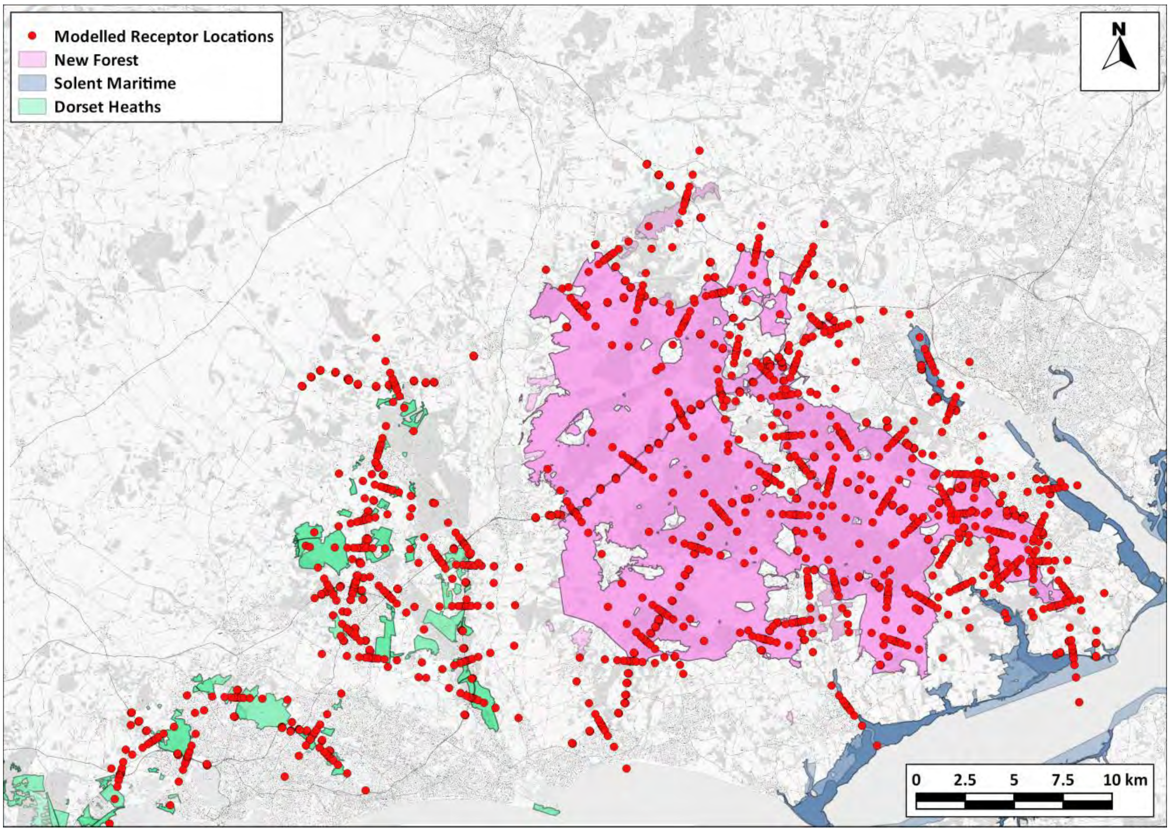

Figure 1: Modelled Transects and Study Area

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3.4 Predictions of all pollutants have been carried out for a current base year (2015), and future assessment years of 2026 and 2036. Predictions for 2026 and 2036 have been made for two scenarios:

- the Do-Minimum, which includes committed development[3] and background traffic growth to each assessment year, but no Local Plans; and
- the Do-Something, which includes committed development, background traffic growth to each assessment year, and the Local Plans.

3.5 In addition, predictions have been made for an adapted-2015 scenario, which involves combining the base year (2015) traffic flows with 2026 and 2036 vehicle emission factors to allow the 'In-Combination' impacts to be calculated (see below).

3.6 The results for these scenarios have been compared against one-another to show the impacts of the Local Plans, and also the impacts of the Local Plans 'In-Combination' with committed development and background traffic growth[4]. This has been done as follows:

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[3] This takes into account an additional 1,000 dwellings for the Roeshot development in Christchurch.

- the impacts of the Local Plans in 2026 and 2036 have been determined by comparing the Do-Something scenarios in these years against the concurrent Do-Minimum scenarios; and
- the 'In-Combination' impacts in 2026 and 2036 have been determined by comparing each Do-Something scenario against the predictions made in these years using the 2015 traffic flows and the relevant future-year emissions factors.

3.7 In addition to this set of predictions, a sensitivity test has been carried out for nitrogen dioxide and NOx. This involves assuming much higher NOx emissions from certain vehicles than have been used by Defra, using AQC's Calculator Using Realistic Emissions for Diesels (CURED v2A) tool (AQC, 2016a). This is to address the potential under-performance of emissions control technology on modern diesel vehicles (AQC, 2016b). There are thus two scenarios for each future year (both for the Do-Minimum and Do-Something): a base scenario ('official'), using Defra's 'official' emission forecasts, using the Emission Factor Toolkit (EFT) v7.0; and a sensitivity test, using AQC's CURED v2A tool, which allows for the greater real-world emissions from diesel vehicles[5].

3.8 It has not been possible to predict future year ammonia concentrations with any degree of certainty. A best estimate has been calculated by multiplying the base-year-specific (2014) values for each 5x5 km grid square by the expected change in national ammonia emissions between the base year (2015) and the future assessment years. Defra has calculated the UK total ammonia emissions in 2015 to be 272.11 kt, and predicted that the emissions in the future will be 283.82 kt in 2020, 288.93 kt in 2025, and 294.33 kt in 2030. Interpolating between the 2025 and 2030 values gives an estimate for 2026 of 290.01 kt. The reported value for 2030 has been used for 2036. This is a simplification of what is likely to happen (for example, changes in the emissions of acidic gases over this period will change the behaviour of ammonia), but nonetheless will provide a useful estimate.

3.9 Nitrogen deposition is influenced, amongst other factors, by concentrations of NOx and ammonia, however, the relationship between these emissions and nitrogen deposition is non-linear due to the changes to the chemical processing of NOx species in the atmosphere. Future concentrations of NOx are expected to fall (see Paragraph 3.16 to 3.18), albeit not as rapidly as historically predicted. On the other hand, ammonia levels are predicted to increase into the future, primarily due to changes in agricultural processes (Defra, 2012). There is also a concern that ammonia emissions from road traffic may increase in the future (ammonia is produced as a by-product of the catalytic control units used to reduce NOx emissions); this is discussed further in Paragraph 3.19.

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[4] The Habitats Regulations requires the competent authority to assess whether a plan or project is likely to have a significant effect on a European Site either alone or in combination with other plans and projects. There is currently no guidance on how to complete an 'In-Combination' assessment, however, the methodology adopted for this assessment considers the effects of all changes in traffic that are expected to occur between the current 2015 baseline and each of the 2026 and 2036 Do-Something scenarios, which is considered a robust approach.

[5] Since the modelling was carried out Defra has issued a new version of the EFT, (version 8). AQC has carried out some initial testing that indicates that EFT v8 produces similar results to those of the CURED v2A model, especially in 2026, while in 2036 the CURED model produces higher concentrations. On this basis it is not considered necessary to re-model using EFT v8.

Background deposition rates have been factored forward by individually considering both the oxidised and reduced nitrogen deposition components, with the total background nitrogen deposition rate taken as the sum. In order to factor the reduced nitrogen deposition concentration from 2015 to 2026 and 2036 respectively, the same approach as for ammonia has been used; multiplying the average reduced nitrogen concentration for each 5x5 km grid square by the ratio of Defra's predicted UK total ammonia emissions in 2026 (290.01 kt) or 2030[6] (294.33 kt) to those in 2015 (272.11 kt). In order to uplift the oxidised nitrogen deposition component, Defra's maps of ambient background NOx concentrations in 2015, 2026 and 2030[3] for all 1 x 1 km grid squares covering the receptors have been obtained. The ratio of the assessment year (2026 or 2036) prediction to the 2015 prediction for each square has then been calculated. On average, the predictions for 2026 and 2036 are 71% and 68% respectively of those in 2015. The 2015 background fluxes have thus been multiplied by 0.71 and 0.68 to estimate 2026 and 2036 values. For the sensitivity tests, the predictions for 2026 and 2036 have been factored by 0.77 and 0.74 respectively.

3.10 Nitrogen deposition fluxes have been derived from the predicted concentrations of nitrogen dioxide, and ammonia concentrations from the predicted NOx concentrations. Details of the method for calculating both ammonia concentrations and nitrogen deposition fluxes are provided in Appendix A2.

3.11 Concentrations have been predicted using the ADMS-Roads dispersion model. Traffic data for the assessment have been provided by Systra on behalf of New Forest District Council and the New Forest National Park Authority. The predicted increase in traffic is based on the trajectory of both Local Plan land allocations, as outlined in the local development proposals. Details of the traffic data, model inputs, assumptions and the verification are provided in Appendix A2, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

3.12 For each of the modelled scenarios the maximum predicted concentrations and deposition fluxes within the assessed ecological areas have been presented in the results tables. Where the predicted changes are above the relevant screening criteria, figures showing the areas of exceedance are provided in Section 6.

Uncertainty in Road Traffic Modelling Predictions

3.13 There are many components that contribute to the uncertainty of modelling predictions. The dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. The traffic data used for this assessment are set out in Appendix A2. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

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[6] 2030 is the latest year that data is available for, and therefore has been used in the modelling for 2036.

3.14 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A2). Since the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2015) concentrations.

3.15 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.

3.16 Historically, large reductions in emissions of NOx have been projected, which has led to significant reductions in nitrogen dioxide concentrations from one year to the next being predicted. Over time, it was found that trends in measured concentrations did not reflect the rapid reductions that Defra and DfT had predicted (Carslaw et al., 2011). This was evident across the UK, although the effect appeared to be greatest in inner London; there was also considerable inter-site variation. Emission projections over the 6 to 8 years prior to 2009 suggested that both annual mean NOx and nitrogen dioxide concentrations should have fallen by around 15-25%, whereas monitoring data showed that concentrations remained relatively stable, or even showed a slight increase. Analysis of more recent data for 23 roadside sites in London covering the period 2003 to 2012 showed a weak downward trend of around 5% over the ten years (Carslaw and Rhys-Tyler, 2013), but this still falls short of the improvements that had been predicted at the start of this period.

3.17 The reason for the disparity between the expected concentrations and those measured relates to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have had to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the emissions of NOx from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles has often been no better than that of earlier models. This has been compounded by an increasing proportion of nitrogen dioxide in the NOx emissions, i.e. primary nitrogen dioxide, which has a significant effect on roadside concentrations (Carslaw et al., 2011) (Carslaw and Rhys-Tyler, 2013).

3.18 A detailed analysis of emissions from modern diesel vehicles has been carried out (AQC, 2016b). This shows that, where previous standards had limited on-road success, the ‘Euro VI’ and ‘Euro 6’ standards that new vehicles have had to comply with from 2013/16[7] are delivering real on-road improvements. A detailed comparison of the predictions in Defra’s latest Emission Factor Toolkit (EFT) v7.0 against the results from on-road emissions tests has shown that Defra’s latest predictions still have the potential to under-predict emissions from some vehicles, albeit by less than has historically been the case (AQC, 2016b) [8]. In order to account for this potential under-prediction, a sensitivity test has been carried out in which the emissions from Euro IV, Euro V,

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[7] Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

[8] See update in footnote 5.

Euro VI, and Euro 6 vehicles have been uplifted as described in Paragraph A2.6 in Appendix A2, using AQC's CURED (V2A) tool (AQC, 2016a).

3.19 Much less research has been carried out into ammonia emissions from vehicles than into NOx emissions and so all projections are more tenuous. A large part of the problem is that, while NOx emissions from new vehicle models are regulated by European legislation, ammonia emissions are not. Furthermore, Selective Catalytic Reduction (SCR) technology, which is often used to help achieve the NOx emissions standards, has the potential to be a source of ammonia. The way in which the NOx emissions standards are implemented for light-duty diesel vehicles is set to become more stringent by 2020 and it is not unreasonable to assume that vehicle manufacturers will meet this challenge with more emphasis on SCR technology and, potentially, with higher dosing rates of the reagents which can give rise to ammonia emissions. While this is, largely, speculation, it does not seem unreasonable to conclude that ammonia emissions per vehicle may increase in the future. This effect is not taken into account within the Calculation of Emissions from Road Transport (COPERT) model (V5.0.1067), which is produced by the European Environment Agency and is expected to be used by the majority of European member states for reporting to the European Commission. The COPERT model predicts that, while NOx emissions from newly-manufactured diesel cars will fall between 2016 and 2020, there will be no associated change in ammonia emissions. On the other hand, Defra's predictions, which were made earlier, suggest that ammonia emissions from road traffic will reduce into the future (Defra, 2012).

4 Existing Baseline and Future Do-Minimum Conditions

National Background Maps for NOx and nitrogen dioxide

4.1 Estimated background concentrations of NOx and nitrogen dioxide in the study area have been determined for 2015 and the future years of 2026 and 2036 using Defra's background maps (Defra, 2017a). The background concentrations are set out in Table 3 and have been derived as described in Appendix A2. The background concentrations are all below the critical level.

Table 3: Estimated Annual Mean Background Pollutant Concentrations in 2015, 2026 and 2036 (µg/m^3)

Year	NO_x	Nitrogen Dioxide [a]
2015 [b]	9.6 – 29.9	7.3 – 20.0
2026 'Official' [b]	6.7 – 26.6	5.2 – 18.1
2026 Sensitivity Test [c]	*7.0 – 27.4*	*5.4 – 18.6*
2036 'Official' [b]	6.2 – 26.1	4.9 – 17.8
2036 Sensitivity Test [c]	*6.6 – 27.0*	*5.1 - 18.4*
Critical Level	**30**	**-**

The range of values is for the different 1x1 km grid squares covering the study area.

[a] Nitrogen dioxide backgrounds have been used to convert the NOx model outputs into road nitrogen dioxide for the purposes of calculating the nutrient-nitrogen deposition.

[b] In line with Defra's forecasts

[c] Assuming higher emissions from modern diesel vehicles as described in Appendix A2.

National Background Ammonia Map

4.2 Background ammonia concentrations in the study area have been taken from the UK Deposition Data website operated by the Centre for Ecology and Hydrology (Centre for Ecology and Hydrology, 2017) for 2014 (the latest available year) and factored forwards to the future years of 2026 and 2036. The 2026 and 2036 values have been derived by projecting forward the 2014 values following the methodology described in Paragraph 3.8. The ranges in background ammonia concentrations show that in some areas the critical level is exceeded in both future assessment years.

Table 4: Estimated Background Ammonia Concentrations in 2014, 2026 and 2036 (µg/m^3) [a]

Year	Ammonia
2014	0.57 – 2.35
2026	0.61 – 2.51
2036	0.61 – 2.54
Critical Level	**1**

[a] 2014 is the latest available year for concentrations of ammonia.

Background Deposition

4.3 Background nitrogen deposition fluxes to the study area have been taken from the UK Deposition Data website operated by the Centre for Ecology and Hydrology (Centre for Ecology and Hydrology, 2017) for 2014 (the latest available year) and factored forwards to the future years of 2026 and 2036, as described in Paragraph 3.9. The range in critical loads assessed against is 8 - 20 (see Table 2), and therefore background nutrient-nitrogen deposition rates are likely to be above the critical load at some locations in all modelled scenarios.

Table 5: Estimated Annual Mean Background Nitrogen Deposition Flux (kgN/ha/yr) [a]

Year	Nutrient-Nitrogen Deposition
2014	9.8 – 21.4
2026 'Official' [b]	8.6 – 19.6
2026 Sensitivity Test [c]	8.9 – 20.2
2036 'Official' [b]	8.6 – 19.6
2036 Sensitivity Test [c]	8.9 – 20.1
Critical Load Range	**8 - 20**

[a] 2014 is the latest available year for concentrations of ammonia that contribute to then nutrient deposition.

[b] Based on Defra's forecasts for the NOx background used to uplift the oxidised nitrogen component.

[c] Assuming higher emissions from modern diesel vehicles in the NOx background for uplifting the oxidised nitrogen component as described in Appendix A2.

Existing Baseline and Future Do-Minimum Model Results

4.4 The maximum concentrations of NOx, for the 2015 baseline, and 2026 and 2036 Do-Minimum scenarios, are set out in Table 6. The maximum concentrations occur at two locations; alongside the M27 eastbound and the A337 southbound, both 1 m from the roadside. Annual mean concentrations of NOx significantly exceed the critical level at these worst-case locations in all scenarios. Even when assuming that vehicle emissions reduce in line with Defra's forecast, there are predicted to be exceedances of the annual mean critical level in 2026 and 2036.

Table 6: Maximum Baseline and Do-Minimum NOx Concentrations [a]

Receptor	Maximum Concentration (µg/m^3)
2015 [b]	**222.3**
2015 Sensitivity Test [c,d]	**228.8**
2026 [b]	**111.0**
2026 Sensitivity Test [c,d]	**174.1**
2036 [b]	**106.1**
2036 Sensitivity Test [c,d]	**178.3**
Critical Level	30

[a] Exceedances of the critical level are shown in bold.

[b] In line with Defra's forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

[d] The methodology for the sensitivity test uses different traffic emissions and required a separate verification (see Appendix A2), which leads to slightly different values.

4.5 Annual mean concentrations of NOx in the 2015 baseline are predicted to exceed the critical level of 30 µg/m^3 in many locations. Adjacent to isolated roads (i.e where only a single road primarily contributes NOx emissions), exceedances are observed at 160 m from the road edge. Where several roads contribute to the total road NOx, such as junctions, baseline concentrations of NOx are predicted to exceed the critical load at 320 m from the road edge (for instance, around the junction between the A31 and M27).

4.6 Exceedances of the critical level in 2026 and 2036 Do-Minimum appear to be constrained to locations along the A31 and M27, with isolated exceedances around the A36 and A35 in Totton. Annual mean concentrations are predicted to exceed the critical level at 40 m from the roadside, occurring adjacent to the M27 eastbound. In most of the other locations, exceedances of the critical level are observed at 20 m from the roadside. It is worth noting that the critical level is exceeded at 640 m from the westbound carriageway of the A35, however, the Defra maps show the predicted background concentration of NOx to be significantly greater in this 1 x 1 km grid square (~32 µg/m^3) than the adjacent grid squares (15 – 21 µg/m^3). This is most likely influenced by the surrounding built up urban area, and is the likely governing factor in the exceedance at this distance from the road.

4.7 When considering the sensitivity tests, exceedances of the critical level are observed at 80 m from the roadside at locations alongside the westbound carriageway of the A31, and eastbound M27 carriageway.

4.8 No background 24-hour mean NOx concentrations are available, therefore baseline 24-hour mean concentrations have not been calculated. The worst-case assumption has been made that they already exceed the 24-hour mean NOx critical level at locations close to the roadside.

4.9 Baseline and Do-Minimum nutrient-nitrogen deposition rates within the study area in 2015, 2026 and 2036 are set out in Table 7. Since the maximum critical load assessed against is 20 (see Table 2), baseline and Do-Minimum nutrient-nitrogen deposition rates are likely to be above the critical load at some locations in all modelled scenarios.

Table 7: Maximum Baseline and Do-Minimum Nutrient-Nitrogen Deposition Rates (kgN/ha/yr)

Receptor	Nutrient Nitrogen Deposition Rates (kgN/ha/yr)
2015 [a]	41.7
2015 Sensitivity Test [b]	*41.2*
2026 [a]	30.2
2026 Sensitivity Test [b]	*36.1*
2036 [a]	29.5
2036 Sensitivity Test [b]	*36.1*
Critical Load Range	8 - 20

[a] In line with Defra's 'official' forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5 Screening Assessment

Impacts of Local Plans

5.1 As explained in Paragraph 3.6, the changes caused by the Local Plans have been determined by comparing the Do-Something scenarios against the concurrent Do-Minimum Scenarios. The maximum changes in predicted concentrations of NOx in 2026 and 2036 are set out in Table 8. The table shows the maximum predicted changes in concentration at any of the modelled receptors within the study area. The absolute changes are presented along with changes as a percentage of the critical level in parenthesis. The maximum changes in rates of nutrient-nitrogen deposition and ammonia in 2026 and 2036 are set out in Table 9 and Table 10. Again the absolute changes are presented along with the changes as a percentage of the critical load in parenthesis.

Table 8: Predicted Maximum Changes in NOx Concentrations Relative to the Critical Level (Comparing Do-Something with Do-Minimum) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
Annual Mean NOx (µg/m^3)		
2026	19.4 (64.6%)	*31.5 (104.9%)*
2036	8.4 (28.1%)	*14.1 (46.9%)*
Screening Criterion	**30 (1%)**	
24hr-Mean NOx (µg/m^3)		
2026	173.6 (231.4%)	*284.8 (379.7%)*
2036	40.1 (53.5%)	*66.2 (88.2%)*
Screening Criterion	**75 (10%)**	

[a] Absolute changes are presented in µg/m^3 along with the changes as a percentage of the critical level in parenthesis.

[b] In line with Defra's 'official' forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.2 In all model scenarios, the change in annual mean concentration of NOx is greater than 1% of the critical level at the worst-case location within the study area (Table 8). Contour plots showing where the changes are greater than 1% are shown in Figure A3.2 and Figure A3.4 (for 2026) and Figure A3.12 and Figure A3.14 (for 2036). The potential for significant impacts cannot be discounted and further assessment should thus be carried out. In all model scenarios, the change in 24-hour mean NOx concentrations is greater than 10% of the critical level at the worst-case location within the study area. Contour plots showing where the changes are greater than 10% are shown in Figure A3.5 and Figure A3.6 (for 2026) and Figure A3.15 and Figure A3.16 (for 2036).

Therefore, the potential for significant impacts cannot be discounted and further assessment is also required of 24-hour mean NOx concentrations.

Table 9: Maximum Changes in Nitrogen Deposition Rates Relative to the Critical Load (Comparing Do-Something with Do-Minimum) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
2026	1.4 (14.2%)	*2.2 (21.9%)*
2036	0.8 (8.2%)	*1.2 (11.6%)*
Screening Criterion	**1%**	

[a] Absolute changes are presented in kg-N/ha/yr along with the changes as a percentage of the critical load in parenthesis.

[b] In line with Defra's 'official' forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.3 Changes in nutrient-nitrogen deposition rates are predicted to be greater than 1% of the critical load (Table 9). Contour plots showing the absolute changes are shown in Figure A3.9 and Figure A3.10 (for 2026) and Figure A3.19 and Figure A3.20 (for 2036). Therefore the potential for significant impacts cannot be discounted and further assessment is required in relation to nitrogen deposition.

Table 10: Maximum Changes in Ammonia Relative to the Critical Level (Comparing Do-Something with Do-Minimum) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
2026	0.6 (58.1%)	*0.9 (94.3%)*
2036	0.3 (25.3%)	*0.4 (42.5%)*
Screening Criterion	**1 (1%)**	

[a] Absolute changes are presented in kg-N/ha/yr along with the changes as a percentage of the critical load in parenthesis.

[b] In line with Defra's 'official' forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.4 Changes in ammonia concentrations are predicted to be greater than 1% of the critical load for all modelled scenarios (Table 10). Contour plots showing where the changes are greater than 1% are shown in Figure A3.7 and Figure A3.8 (for 2026) and Figure A3.17 and Figure A3.18 (for 2036). Therefore the potential for significant impacts cannot be discounted and further assessment is required in relation to ammonia.

'In-Combination' Impacts

5.5 As explained in Paragraph 3.6, the 'In-Combination' impacts have been determined by comparing the Do-Something scenarios against model scenarios which combine existing baseline (2015) traffic flows with future-year emissions factors. The maximum changes in predicted concentrations of NOx, nutrient-nitrogen deposition and ammonia for the 'In-Combination' scenarios are presented in Table 11, Table 12 and Table 13.

Table 11: Predicted Maximum Changes in NOx Concentrations Relative to the Critical Level for 'In-Combination' Impacts (Comparing Do-Something with Existing Baseline*) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
Annual Mean NOx		
2026	19.3 (64.3%)	*29.8 (99.3%)*
2036	33.2 (110.7%)	*55.3 (184.2%)*
Screening Criterion	**30 (1%)**	
24-Hour NOx		
2026	94.2 (135.7%)	*144.5 (192.7%)*
2036	161.5 (215.3%)	*266.3 (355.1%)*
Screening Criterion	**75 (10%)**	

* Existing baseline traffic combined with future-year emissions factors.

[a] Absolute changes are presented in µg/m^3 along with the changes as a percentage of the critical level in parenthesis.

[b] In line with Defra's 'official' forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.6 In all model scenarios, the change in annual mean concentration of NOx is greater than 1% of the critical level at the worst-case location within the study area (Table 11). Contour plots showing where the changes are greater than 1% are shown in Figure A3.21 and Figure A3.22 (for 2026) and Figure A3.29 and Figure A3.30 (for 2036). The potential for significant impacts cannot be discounted and further assessment should thus be carried out. In all model scenarios, the change in 24-hour mean NOx concentrations is greater than 10% of the critical level at the worst-case location within the study area. Contour plots showing where the changes are greater than 10% are shown in Figure A3.23 and Figure A3.24 (for 2026) and Figure A3.31 and Figure A3.32 (for 2036). Therefore, the potential for significant impacts cannot be discounted further assessment is also required of 24-hour mean NOx concentrations.

Table 12: Maximum Changes in Nitrogen Deposition Rates Relative to the Critical Load for 'In-Combination' Impacts (Comparing Do-Something with Existing Baseline*) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
2026	2.0 (19.7%)	*2.6 (26.2%)*
2036	3.4 (33.9%)	*4.7 (47.4%)*
Screening Criterion	**1%**	

* Existing baseline traffic combined with future-year emissions factors.

[a] Absolute changes are presented in kg-N/ha/yr along with the changes as a percentage of the critical load in parenthesis.

[b] In line with Defra's 'official' forecasts

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.7 Changes in nutrient-nitrogen deposition rates are predicted to be greater than 1% of the critical load (Table 12). Contour plots showing absolute changes are shown in Figure A3.27 and Figure A3.28 (for 2026) and Figure A3.35 and Figure A3.36 (for 2036). Therefore the potential for significant impacts cannot be discounted and further assessment is required in relation to nitrogen deposition.

Table 13: Maximum Changes in Ammonia Relative to the Critical Level for 'In-Combination' Impacts (Comparing Do-Something with Existing Baseline*) [a]

Scenario	'Official' [b]	*Sensitivity Test* [c]
2026	0.6 (57.8%)	*0.9 (89.3%)*
2036	1.0 (99.6%)	*1.7 (166.0%)*
Screening Criterion	**1 (1%)**	

* Existing baseline traffic combined with future-year emissions factors.

[a] Absolute changes are presented in kg-N/ha/yr along with the changes as a percentage of the critical load in parenthesis.

[b] In line with Defra's forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

5.8 Changes in ammonia concentrations are predicted to be greater than 1% of the critical level for all modelled scenarios (Table 13). Contour plots showing where the changes are greater than 1% are shown in Figure A3.25 and Figure A3.26 (for 2026) and Figure A3.33 and Figure A3.34 (for 2036). Therefore the potential for significant impacts cannot be discounted and further assessment is required in relation to ammonia.

6 Further Assessment

Annual Mean NOx Concentrations

6.1 The maximum total annual mean NOx concentrations in the Do-Something scenario are provided in Table 14 for the receptor with the maximum concentration. Despite the expected reductions in vehicle emissions between 2026 and 2036, total NOx concentrations are predicted to increase, as a result of larger vehicle flows travelling through the study area by 2036, the year of plan completion.

Table 14: Maximum Total NOx Concentrations in Study Area (µg/m^3) Do-Something [a]

Scenario	'Official' [b]	*2026 Sensitivity Test* [c, d]
2026	**112.3**	***174.0***
2036	**114.6**	***188.4***
Critical Level	**30**	

[a] Exceedances of the objective are shown in bold.

[b] In line with Defra's forecasts.

[c] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

[d] The methodology for the sensitivity test uses different traffic emissions and required a separate verification (see Appendix A2), which leads to slightly different values.

6.2 Contour plots showing total NOx concentrations are presented in Figure A3.1, Figure A3.3, Figure A3.11 and Figure A3.13. The further assessment only considers areas where the critical level of 30 µg/m^3 is predicted to be exceeded in the Do-Something scenario. Furthermore, in the discussion below, where the changes in concentration are below 1% of the critical level, impacts are discounted as insignificant, irrespective of the total concentration.

Impacts of Local Plans

6.3 As explained in Paragraph 3.6, the changes caused by the Local Plans have been determined by comparing the Do-Something scenarios against the concurrent Do-Minimum scenarios. In 2026, predicted exceedances of both the critical level of 30 µg/m^3 (in the Do-Something scenario) and the screening criterion of 1% (when comparing the Do-Something to Do-Minimum scenarios) are mainly along the A337 and A35. These are two of the main roads that bisect the New Forest, with exceedances occurring at 5 m from the roadside of the A337 and at 2 m from the A35. However, exceedances at 5 m do not occur along the full length of the A337. Exceedances within the Solent are also predicted, adjacent to the A36, at 15 m from the roadside. As described in Paragraph 4.6, background concentrations in this 1 x 1 km grid square are significantly higher than in adjacent grid squares, and therefore this will contribute to causing the exceedance. In the 2026 sensitivity test, where the predicted increase is more than 1 %, annual mean NOx concentrations are predicted to be above 30 µg/m^3 at 15 m from the roadside of the A337 in Pikeshill. This extent does not occur along the entire length of the A337, with other locations demonstrating exceedances between 1 and 4 m from the roadside.

6.4 Exceedances in 2036 continue to occur along the A337 and A35, albeit extending along a significantly greater proportion of the roads than in 2026. There are additional exceedances predicted around the junction between the A31 and M27, at 20 m from the roadside, likely a result of the busy road network contributing significant vehicle emissions. In the sensitivity test, exceedances of the critical level occur between 1 and 4 m from the roadside of the A35, with the exception of one location in Lyndhurst where an exceedance is predicted at 20 m. Along the A337 exceedances are predicted at 20 m in several locations, with the worst impacts predicted on the eastern side of the road, consistent with prevailing wind direction. Figure 2 presents these locations with exceedances of the critical level and screening criterion, for the scenario which is considered to be the most worst-case (2036 sensitivity test).

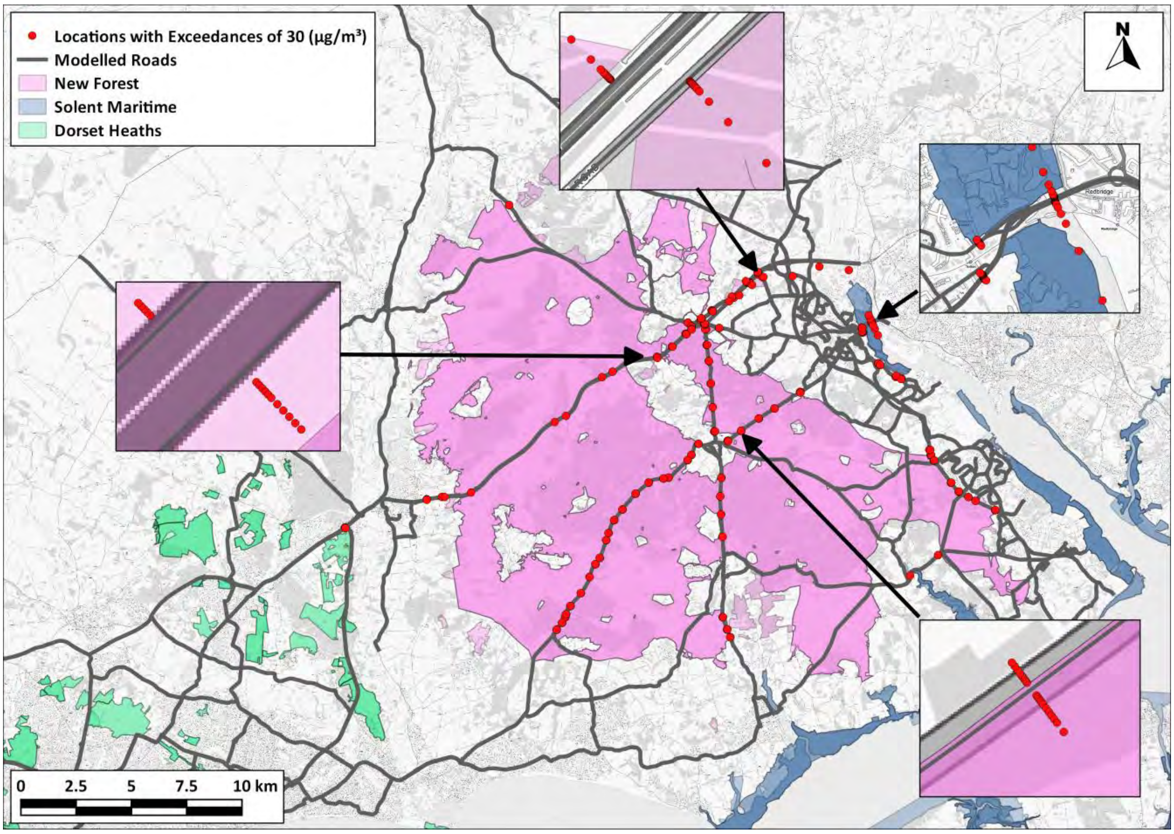

Figure 2: **Receptors where Both Total Annual Mean NOx is above 30 µg/m^3 in the Do-Something Scenario and the Change in Concentration between the Do-Minimum and Do-Something Scenarios is Greater than 1% in 2036 – Results from the Sensitivity Test**

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'In-Combination' Impacts

6.5 As explained in Paragraph 3.6, the 'In-Combination' impacts have been determined by comparing the Do-Something scenarios against model scenarios which combine existing baseline (2015) traffic flows with future-year emissions factors. The total concentrations are thus no different from those described in the 'Impacts of Local Plan' section, but are described separately here since the 'In-Combination' changes add additional areas where the 1% screening criterion is exceeded, and thus re-frame the interpretation of the Do-Something totals.

6.6 As highlighted in Table 11, the changes in annual mean concentrations of NOx are above the relevant screening criterion for all modelled 'In-Combination' scenarios. The following paragraphs only discuss areas where both an exceedance of the screening criterion (comparing the adapted-2015 and Do-Something Scenarios) and critical level of 30 µg/m^3 (in the Do-Something Scenario) occur.

6.7 In 2026, along the A35, annual mean concentrations are predicted to be above 30 µg/m^3 at distances of between 1 and 4 m from the roadside. On the A337, south of Goose Green, exceedances are predicted at 1 m from the roadside, whereas to the north, exceedances are predicted between 1 and 4 m from the road edge, on both sides of the road. Exceedances extend to 7 m from the roadside along the eastern carriageway of the A31, whilst they extend to between 15 and 20 m from the roadside along the western carriageway. Adjacent to the M27 exceedances of 30 µg/m^3 are predicted at 40 m from the roadside. Exceedances of the critical level at 640 m from the roadside occur on the A35 near Redbridge, however, this is likely a consequence of the elevated background concentrations due to its proximity to the surrounding built up urban area rather than a direct influence of the Local Plans. Exceedances occur along the full length of the identified roads.

6.8 The results from the sensitivity test are not materially different from those described in Paragraph 6.7, with the exception that exceedances are also identified adjacent to the junction between the M27 and A31, which occur at 80 m from the roadside. Exceedances also occur at 7 m from the roadside along the B3078 which were not present in the 'official' modelling results. Exceedances extend to 20 m from the roadside along the eastern carriageway of the A31, whilst they extend to 40 m along the western carriageway. Exceedances of the critical level are identified along the A338, which passes through the Dorset Heaths, with exceedances at 3 m from the roadside on the southbound carriageway. Exceedances extend to 80 m from the roadside adjacent to the junction between the A31 and A338 in the East Dorset District.

6.9 The 'In-Combination' impacts in 2036 are not materially different to those discussed for 2026 (Paragraph 6.7), although no exceedances are identified in the 2036 Do-Something along the A35, apart from near Redbridge. The 2036 'In-Combination' sensitivity test results are similar to those discussed for the 2026 'In-Combination' sensitivity test. Figure 3 presents these locations with exceedances of the critical level (in the Do-Something Scenario) and screening criterion (comparing the adapted-2015 and Do-Something Scenarios), for the scenario which is considered to be the most worst-case (2036 'In-Combination', sensitivity test).

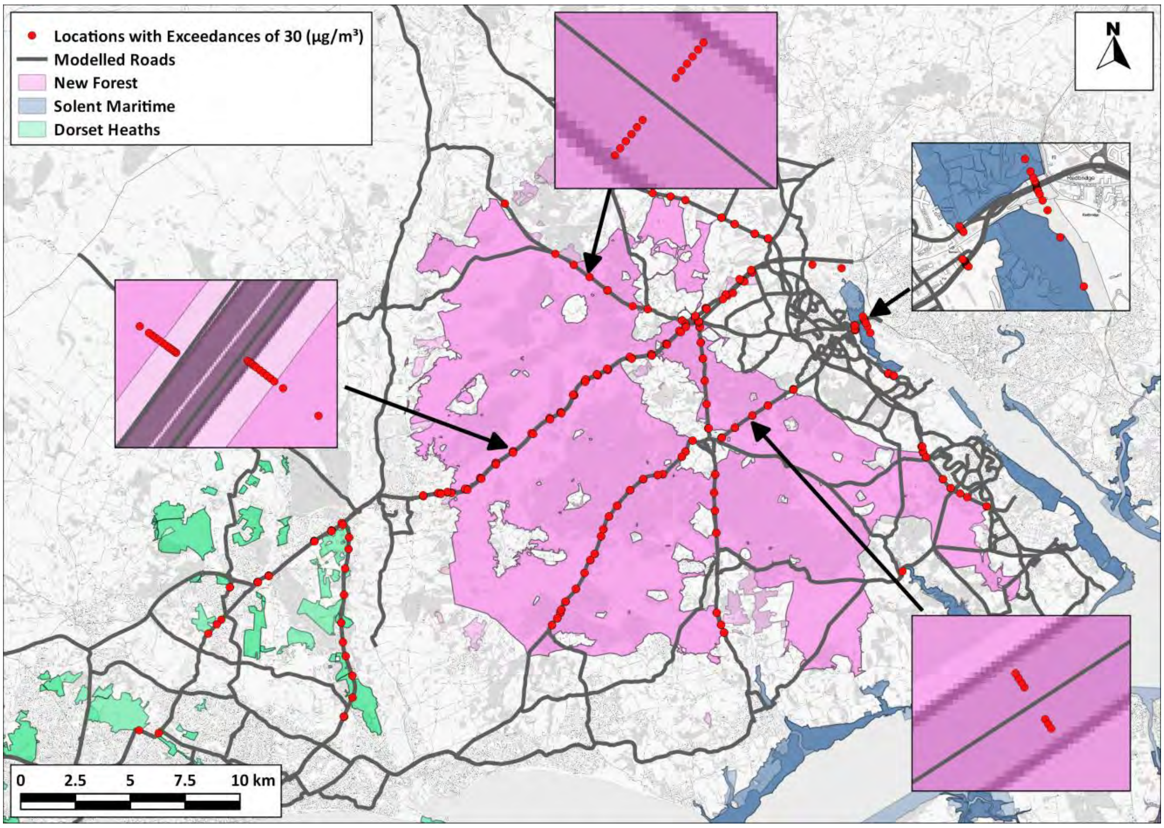

Figure 3: **Receptors where Both Total Annual Mean NOx is above 30 μg/m^3 in the Do-Something Scenario and the Change in Concentration between the adapted-2015 and Do-Something Scenarios is Greater than 1% in 2036 – Results from the Sensitivity Test**

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Discussion

6.10 As discussed in Paragraphs 3.16 to 3.18 the 'official' Defra-predicted reductions in emissions of NOx, predominantly from diesel vehicles, have not been reflected in ambient measurements across the UK. To address this, the sensitivity-test scenarios have used uplifted emissions to reflect the results of on-road emissions tests. It is expected that there will be an improvement in vehicle emissions, especially by 2036 and thus the actual results will lie between the 'official' and sensitivity test values.

6.11 Detailed analysis of emissions from modern diesel vehicles has been carried out and shows that Euro 6/VI vehicles, which include all new vehicles registered since 2013/16, are delivering real on-road improvements (AQC, 2016b). It is considered that the results for the 'sensitivity test' provide a worst-case upper bound to the predicted annual mean NOx concentrations.

6.12 Under both the 'official' and sensitivity-test scenarios, there are predicted to be several exceedances of both the 1% screening criterion and the critical level of 30 µg/m^3 at varying distances from the roadside. The potential for significant effects in relation to NOx concentrations cannot be discounted without an analysis of the sensitivity of the habitat to NOx concentrations. Such an analysis does not form part of this report, and is presented separately within the report prepared by BSG Ecology.

24-Hour NOx Concentrations

6.13 No background 24-hour mean NOx concentrations are available; therefore total 24-hour mean concentrations for each scenario have not been calculated. As concluded in the section on baseline conditions (Section 4), the worst-case assumption has been made that there are exceedances of the 24-hour mean NOx critical level at locations close to the roadside (1 m).

Nutrient Nitrogen Deposition

6.14 Variable critical loads have been used depending on the broad habitat and priority habitat classifications. The critical loads range from 8 (for example supralittoral sediment) to 20 (for example littoral sediment) kgN/ha/yr. As presented in Table 9, all modelled scenarios, including the sensitivity test, exceed the screening criterion of 1%. Table 15 outlines the maximum total nitrogen deposition rate for any receptor in each Do-Something scenario.

6.15 When considering the unrounded values, nitrogen deposition rates increase slightly between 2026 and 2036. This is expected since, despite vehicle emissions reducing between 2026 and 2036, the total number of vehicles will be greater in 2036 than 2026, following the trajectory of the housing allocations during the Plan period.

Table 15: Maximum Total Nitrogen Deposition Rates in Study Area (kgN/ha/yr) Do-Something

Scenario	'Official' [a]	*Sensitivity Test* [b]
2026	30.3	*36.3*
2036	30.3	*37.2*
Critical Load Range	**8 – 20 kgN/ha/yr**	

[a] In line with Defra's 'official' forecasts

[b] Assuming higher emissions from modern diesel vehicles as described in Paragraph A2.6 in Appendix A2.

Impacts of Local Plans

6.16 The following paragraphs only discuss locations where the screening criterion of 1% is exceeded.

6.17 In 2026, exceedances of the critical load (in the Do-Something scenario) are observed at all locations where there is predicted to be a greater than 1% change (when comparing the 2026 Do-

Minimum and Do-Something scenarios). These occur at two locations along the A337, both 1 m from the roadside. On the A35, changes greater than 1% are all at 0 m, which are not considered realistic[9]. With respect to the sensitivity test, exceedances are observed at 4 m from the roadside of the southbound A337 carriageway, and at 2 m from the roadside on the northbound A337 carriageway.

6.18 In 2036, exceedances of the critical load (10 and 15 kgN/ha/yr only), at locations where there is also predicted to be a greater than 1% change, are observed along the entire length of the A35, out to 2 m from the roadside. East of Lyndhurst, the exceedances extend to 3 m from the roadside. South of Lyndhurst, along the A337, exceedances of the critical load are predicted at 1 m from the roadside, however north of Lyndhurst, exceedances are predicted at 15 m on the eastern side of the road, and to 9 m on the western side of the road. Exceedances of the critical load are also observed out to 7 m from the road near to the junction 1 of the M27. In the sensitivity test, additional exceedances at locations where there is a greater than 1% change are identified at 1 m from the roadside on Deerleap Lane, and out to 4 m on North Lane. North of Lyndhurst, exceedances are identified out to 20 m from the roadside, whilst south of Lyndhurst, exceedances are predicted out to 11 m on the eastern side of the road and 3 m on the western side of the road. Near to Junction 1 of the M27, exceedances extend to 20 m from the roadside. Figure 4 presents these locations with exceedances of the critical load (in the Do-Something scenario) and the screening criterion (when comparing the Do-Minimum and Do-Something scenarios), for the scenario which is considered to be the most worst-case (2036 sensitivity test).

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[9] Receptors at 0 m from the kerbside were modelled at the request of Natural England, however results are considered unrealistic.

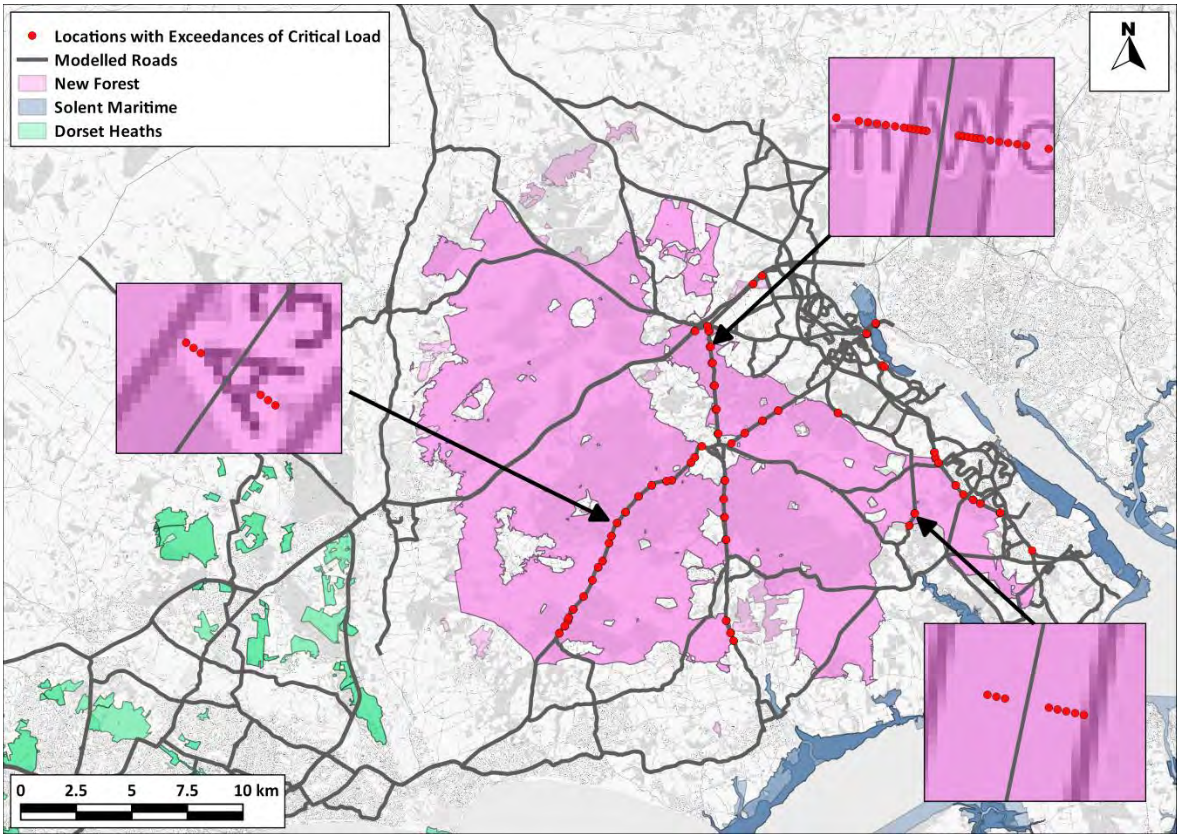

Figure 4: Receptors where Both Nutrient-Nitrogen Deposition is above Respective Critical Load in the Do-Something Scenario and Change in Deposition between the Do-Minimum and Do-Something Scenarios is Greater than 1% of the Critical Load in 2036 – Results from the Sensitivity Test

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'In-Combination' Impacts

6.19 As explained in Paragraph 3.6, the 'In-Combination' impacts have been determined by comparing the Do-Something scenarios against model scenarios which combine existing baseline (2015) traffic flows with future-year emissions factors. The total deposition fluxes are thus no different from those described in the 'Impacts of Local Plan' section, but are described separately here since the 'In-Combination' changes add additional areas where the 1% screening criterion is exceeded, and thus re-frame the interpretation of the Do-Something totals.

6.20 In 2026, exceedances of the critical load (10 and 15 kgN/ha/yr only) are observed, in the Do-Something scenario, along the entire length of the A35, A337, A31 and A338. Exceedances on the A35, west of Lyndhurst, extend to 40 m on the southbound carriageway, and 20 m on the northbound carriageway. East of Lyndhurst, exceedances vary out to between 2 m and 20 m, on both sides of the road. North of Lyndhurst, on the A337, exceedances are predicted out to 160 m from the roadside on both sides of the road, whereas to the south exceedances of the criterion occur out to 20 m from the roadside. On the A31, exceedances are identified out to 80 m from the roadside, with the exception of near to Junction 1 of the M27, where the criterion is exceeded much further away (up to 1,280 m, although it is likely that the effects are not solely as a result of the A31, but rather conflating influences from the nearby road network). Exceedances are predicted out to 160 m along the A338, within the Dorset Heaths designated area. Exceedances are identified out to 80 m from the roadside of the M27. Exceedances of the critical load (20 kgN/ha/yr) are observed out to 11 to 15 m from the roadside along the B3078. For the sensitivity test, the locations of exceedances are the same as those identified for the 'official' results; however the extent of exceedances is further. In addition, exceedances are predicted along the B3055 (10 and 15 kgN/ha/yr only), out to 5 m from the roadside.

6.21 In the 2036 Do-Something scenario, predicted exceedances of the critical load are not materially different from those identified in Paragraph 6.20 for the 'official' results. There are, however, additional exceedances predicted on the B3054 out to 2 m from the roadside, close to the junction with the A326, out to 20 m and out to 320 m on the A338 where the critical load is 10 kgN/ha/yr. The results for the sensitivity test show widespread exceedances of the critical load. In locations where two roads run parallel to one another, such as the A31 and A35, exceedances are predicted at distances up to 2,500 m. Figure 5 presents these locations with exceedances of the critical load (in the Do-Something scenario) and screening criterion (when comparing the adapted-2015 and Do-Something scenarios), for the scenario which is considered to be the most worst-case (2036 'In-Combination', sensitivity test).

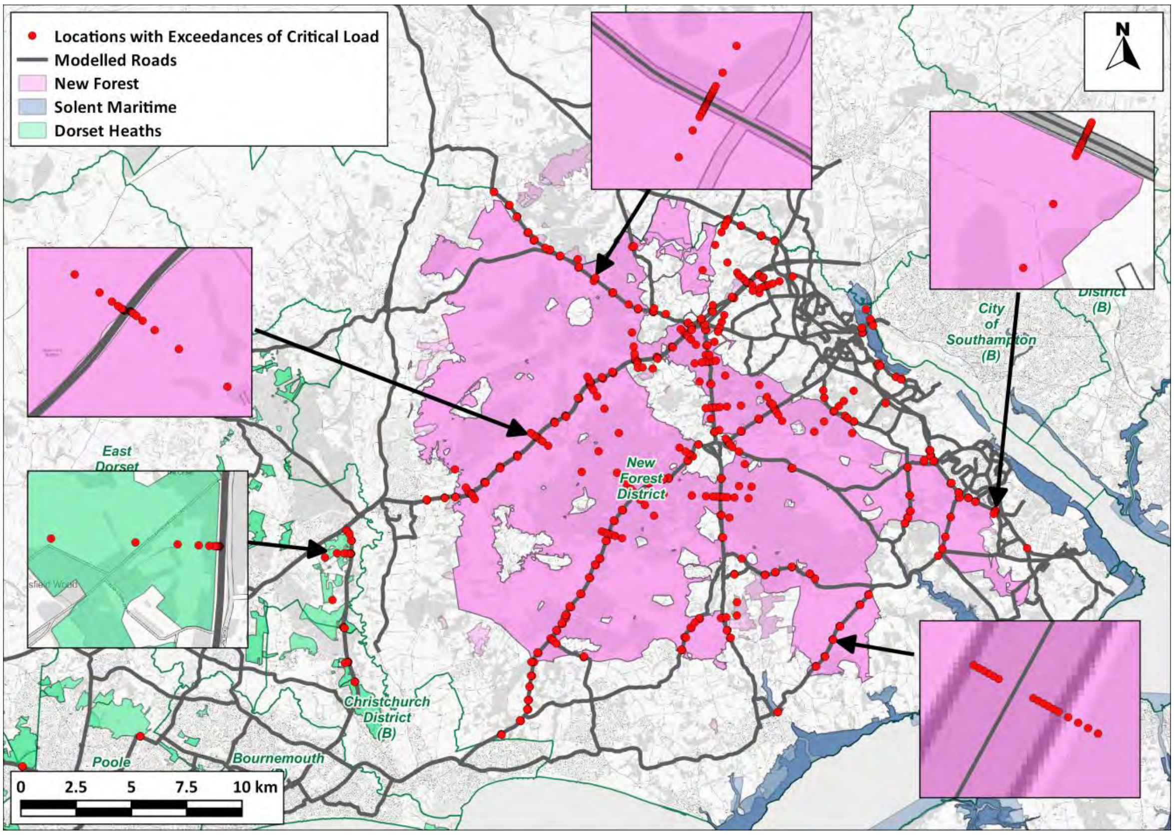

Figure 5: **Receptors where Both Nutrient-Nitrogen Deposition is above Respective Critical Load in the Do-Something Scenario and Change in Deposition between the adapted-2015 and Do-Something Scenarios is Greater than 1% of the Critical Load in 2036 - Results from the Sensitivity Test**

Discussion

6.22 The impacts of nitrogen deposition cannot be discounted without an analysis of the sensitivity of the habitat to nitrogen deposition at those locations identified in Paragraphs 6.14 to 6.21. Analysis of the effects on the habitat does not form part of this report, and is presented separately within the report prepared by BSG Ecology.

Ammonia Concentrations

6.23 Total ammonia concentrations are provided in Table 16 for the receptor with the maximum concentration in the study area. Total ammonia concentrations increase between 2026 and 2036, resulting from an increase in vehicle volumes and also increasing background ammonia concentrations in the study area.

Table 16: Maximum Total Ammonia Concentrations in Study Area (µg/m^3) Do-Something

Scenario	'Official' [a]	*Sensitivity Test* [a]
2026	4.0	*5.8*
2036	4.1	*6.3*
Critical Level	**1**	

[a] In the absence of robust future-year emissions factors, ammonia emissions per vehicle are assumed to fall at the same rate as NOx under each forecast scenario. The nomenclature used to describe the NOx forecasts has thus been used here for consistency.

Impacts of Local Plans

6.24 In 2026 there are exceedances of the critical level along the A337, A35 and the A36 in the Do-Something scenario. Exceedances along the A35 are constrained to a few isolated locations, predominantly in the south west of the New Forest, at 3 m from the roadside. Exceedances along the A337 occur along the entire modelled road length, extending from 1 m to 4 m from the roadside. On the A36 total ammonia concentrations exceed the critical level out to 15 m from the roadside, and further along on the A35 out to 80 m. For the sensitivity test, exceedances occur in similar locations, however occur at more regular intervals along the A35 and at 1 m. Exceedances (which are not predicted in the 'official' Do-Something scenario) are identified at three discrete locations along the A31 at 0 m (not considered as a receptor for this study). Adjacent to the A36 near Redbridge exceedances extend into the Solent ecological site, out to a distance of 320 m from the roadside.

6.25 Locations of exceedances in the 2036 Do-Something scenario are broadly comparable to those described for 2026, although extend across the entire modelled length of the A35 and M27. A pocket of exceedances is also predicted around Junction 1 of the M27, an area where emissions from many busy roads combine. These exceedances occur out to 2 to 5 m from the roadside along the B3079 and 15 to 20 m from the roadside along the A31 (east of the junction) and motorway slip roads. Exceedances of the critical level occur on the B3055, at 1 m on the western side, and out to 3 to 4 m from the roadside on the eastern side. On the A337, north of Lyndhurst, exceedances are predicted at 40 m from the roadside, whereas, to the south, exceedances are predicted out to 9 to 15 m. In Setley, along the A337 exceedances of the critical load are predicted at 40 m from the roadside. On the B3054, which crosses through the south eastern quarter of the New Forest, as well as adjacent to a small area of designated Solent SPA, exceedances of the critical level are observed at 0 m (not considered as a receptor for this study). The results for the sensitivity test are principally very similar, with exceedances also observed along A31 out to 1 to 3 m from the roadside, although this extends out to 9 m on approaching Junction 1. The total ammonia concentration exceeds the critical level along Rolleston Road at 1 m, as well as along the A326 out to 15 m from the roadside. Exceedances of the critical level are observed out to 80 to 160 m from the roadside along the A337. Exceedances of the critical level are predicted along the entire length of the Solent north of the A36. Exceedances on Bury Road, running parallel to the River Test, extend out to 320 m from the roadside, and thus fall within the Solent designated area.

6.26 As explained in Paragraph 3.6, the changes caused by the Local Plans have been determined by comparing the Do-Something scenarios against the concurrent Do-Minimum scenarios. Figure 6 presents these locations with exceedances of the critical level (in the Do-Something scenario) and screening criterion (when comparing the Do-Minimum and Do-Something scenarios), for the scenario which is considered to be the most worst-case (2036 sensitivity test).

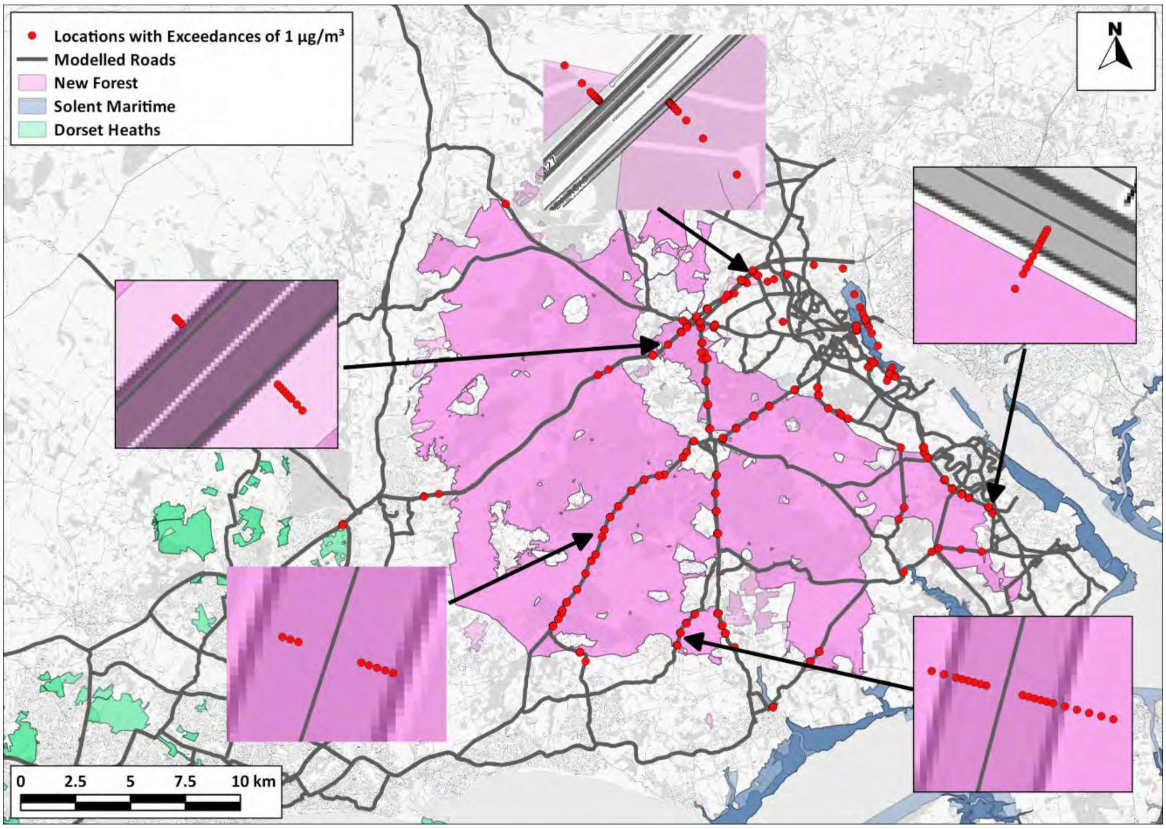

Figure 6: **Receptors where Both Ammonia Concentration is above 1 µg/m³ in the Do-Something Scenario and Change in Concentration between the Do-Minimum and Do-Something Scenarios is Greater than 1%, 2036 – Results from the Sensitivity Test**

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‘In-Combination’ Impacts

6.27 As explained in Paragraph 3.6, the ‘In-Combination’ impacts have been determined by comparing the Do-Something scenarios against model scenarios which combine existing baseline (2015) traffic flows with future-year emissions factors. The total concentrations are thus no different from those described above, but are described separately here since the ‘In-Combination’ changes add additional areas where the 1% screening criterion is exceeded, and thus re-frame the interpretation of the Do-Something totals.

6.28 For all assessment years, and both the ‘official’ and sensitivity tests, exceedances of the critical level are predicted to occur along most 2026 and all 2036 modelled roads. In 2026, these exceedances can, in some cases, extend out to 2,560 m from the roadside, although, it is worth noting that these generally occur in locations where there are several nearby roads all contributing to the total ammonia concentration. Exceedances generally extend out to 320 m from the roadside, and mainly occur along the A31, A337 and A35. Along minor roads, such as the B3054, exceedances are within 20 m of the roadside. In 2036, exceedances extend out to 2,560 m, even along isolated roads, such as the B3078, where there are few roads to contribute to the total ammonia concentration. Figure 7 presents these locations with exceedances of the critical level (in the Do-Something scenario) and screening criterion (when comparing the adapted-2015 and Do-Something scenarios), for the scenario which is considered to be the most worst-case (2036 ‘In-Combination’, sensitivity test).

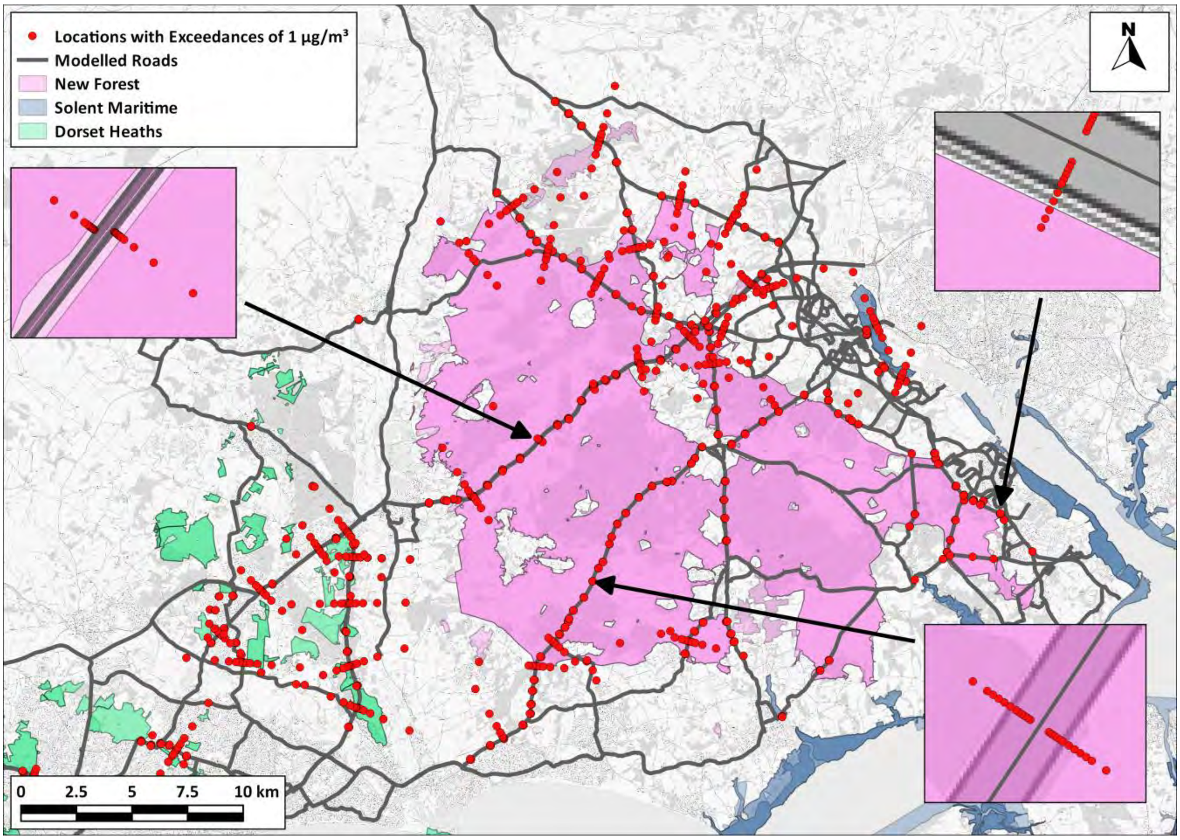

Figure 7: **Receptors where Both Ammonia Concentration is above 1 $\mu g/m^3$ in the Do-Something Scenario and Change in Concentration between the adapted-2015 and Do-Something Scenarios is Greater than 1% of the Critical Load 2036 -Results from the Sensitivity Test**

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Discussion

6.29 Since the increase in ammonia concentrations is predicted to be greater than 1% of the critical level and the total ammonia concentrations already exceed the critical level, it is considered that the potential for significant effects cannot be discounted without an analysis of the sensitivity of the habitat to ammonia concentrations at those locations identified in Paragraphs 6.23 to 6.28. Analysis of the effects on the habitat does not form part of this report, and is presented separately within the report prepared by BSG Ecology.

7 Summary and Conclusions

7.1 An air quality assessment has been completed to assist New Forest District Council and the New Forest National Park Authority with meeting its Habitats Regulations Assessment requirements. The assessment provides information on concentrations of NOx and ammonia, and deposition rates for nitrogen, which will help inform whether the integrity of the New Forest, Dorset Heaths and Southampton Solent ecological sites will be adversely affected by changes in traffic flows due to the New Forest District Council and the New Forest National Park Authority Local Plans.

7.2 Concentrations have been modelled along a series of transects, covering up to 2,560 m from the edge of major roads which run through the designated ecological sites. These include, but are not limited to, the A31, A35, A337 and M27. The assessment has covered two alternative future-year scenarios; 2026, which represents a mid-point in the Local Plans period, and 2036, which represents the year of plan completion.

7.3 Predictions for 2026 and 2036 have been made for two scenarios:

- the Do-Minimum, which includes committed development and background traffic growth, but no Local Plans; and
- the Do-Something, which includes committed development, background traffic growth, and the Local Plans.

7.4 In addition, predictions have been made for an adapted-2015 scenario, which involves combining 2015 traffic flows with 2026 and 2036 vehicle emission factors to allow the 'In-Combination' impacts to be calculated.

7.5 The results for these scenarios have been compared against one-another to show the impacts of the Local Plans, and also the impacts of the Local Plans 'In-Combination' with committed development and background traffic growth. This has been done as follows:

- the impacts of the Local Plans have been determined by comparing each Do-Something scenario against the concurrent Do-Minimum scenario; and
- the In-Combination impacts have been determined by comparing each Do-Something scenario against the concurrent adapted-2015 scenario.

7.6 In terms of vehicle emissions, two future-year scenarios have been considered:

- emissions per vehicle are assumed to reduce in line with Defra's forecasts for NOx; and
- emissions per vehicle reduce at a slower rate than has been assumed for NOx by Defra, taking account of the observed under-performance of modern diesel vehicles.

7.7 These two emissions scenarios have then been used to assess the impacts of NOx emissions from road traffic on NOx and ammonia concentrations and nitrogen deposition, with nitrogen deposition fluxes calculated using published fixed deposition velocities.

Impacts of Local Plans

7.8 In terms of annual mean NO_x concentrations, 24-hour NOx, nutrient-nitrogen deposition and ammonia, it is not possible to discount the potential for significant effects without an analysis of the sensitivity of the habitat at the distances from the road that are highlighted in Section 6.

'In-Combination' Impacts

7.9 The results of the 'In-Combination' impacts are not materially different from the Do-Something Impacts, and therefore it is not possible to discount the potential for significant effects without an analysis of the sensitivity of the habitat at the distances from the road that are highlighted in Section 6.

Outcome

7.10 The next step will be for BSG Ecology to carry out an analysis of whether the habitats within the areas defined in this report have the potential to be affected by nitrogen oxides, nutrient nitrogen deposition and ammonia, and whether the changes in concentrations and deposition rates predicted have the potential to adversely affect the integrity of the designated ecological sites, and present the findings to the New Forest District Council and the New Forest National Park Authority.

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9 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
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)
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
$\mu g/m^3$	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
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
PC	Process Contribution
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

10 Appendices

A1 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Dr Ben Marner, BSc (Hons) PhD CSci MIEnvSc MIAQM

Dr Marner is a Technical Director with AQC and has seventeen years' experience in the field of air quality. He has been responsible for air quality and greenhouse gas assessments of road schemes, rail schemes, airports, power stations, waste incinerators, commercial developments and residential developments in the UK and abroad. He has been an expert witness at several public inquiries, where he has presented evidence on health-related air quality impacts, the impacts of air quality on sensitive ecosystems, and greenhouse gas impacts. He has extensive experience of using detailed dispersion models, as well as contributing to the development of modelling best practices. Dr Marner has arranged and overseen air quality monitoring surveys, as well as contributing to Defra guidance on harmonising monitoring methods. He has been responsible for air quality review and assessments on behalf of numerous local authorities. He has also developed methods to predict nitrogen deposition fluxes on behalf of the Environment Agency, provided support and advice to the UK Government's air quality review and assessment helpdesk, Transport Scotland, Transport for London, and numerous local authorities. He is a Member of the Institute of Air Quality Management and a Chartered Scientist.

Caroline Odbert, BA (Hons) MSc CSci MIEnvSc MIAQM

Ms Odbert is a Senior Consultant with AQC, with over eight years' relevant experience. She is involved in the preparation of air quality assessments for a range of development projects. She has been responsible for a wide range of air quality projects covering impact assessments for new residential and commercial developments, local air quality management, ambient air quality monitoring of nitrogen dioxide and sulphur dioxide and the assessment of nuisance odours. She has extensive modeling experience for road traffic and has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. She is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Frances Marshall, MSci PhD AMIEnvSc AMIAQM

Dr Marshall is a Consultant with AQC, having joined the company in September 2016. She is currently gaining experience of undertaking air quality assessments, including the use of dispersion modelling. Prior to joining AQC, Frances spent four years carrying out postgraduate research into atmospheric aerosols at the University of Bristol. She is an Associate Member of both the Institute of Air Quality Management and The Institute of Environmental Sciences.

Full CVs are available at www.aqconsultants.co.uk.

A2 Modelling Methodology

Model Inputs

A2.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 7.0) published by Defra (2017a).

A2.2 Hourly sequential meteorological data from Bournemouth for 2015 have been used in the model. The Bournemouth meteorological monitoring station is located inland, approximately 24 km to the south west of the centre of the New Forest, and is considered representative of meteorological conditions across the study area.

A2.3 AADT flows, proportions of HDVs and speed data have been provided by Systra, who have undertaken the transport assessment for the Local Plan proposals in the New Forest. It is understood that the traffic data provided for both 2026 'Do-Something' and 2036 'Do-Something' are based on the trajectory of development supplied by New Forest District Council. The figures include growth for both New Forest District Council and the New Forest National Park Authority (800 dwellings as part of the New Forest National Park Authority Local Plan). A summary of the housing trajectory is provided in Table A2.1. The 2026 and 2036 scenarios include background traffic growth based on TEMPro. It is understood that the TEMPro model was also adjusted to include an additional 500 from the Christchurch urban extension.

Table A2.1: Summary of Projected Housing Trajectory for Modelled Scenarios

	Waterside & Fawley PS	South Coast	Avon Downlands	Total
2036				
Commitments, small site potential and windfall trends	1,904	1,449	825	4,178
LP1 Strategic Sites 100+ homes	3,444	941	2,039	6,424
Total Supply	**5,348**	**2,390**	**2,864**	**10,602**

A2.4 Where necessary, such as at roundabouts, traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. Traffic data for nearly 600 road links were provided for the assessment; for simplicity these have been omitted from the report, however are available upon request. Vehicle flows for Exbury Road and Summer Lane, which pass through a section of designated New Forest area, were provided as zero for both assessment years; as such, it has not been possible to assess the impact of the Local Plans on this section of New Forest. Changes in AADT flows, between the baseline and Do-Something scenarios, and the modelled road network are summarised in Figure A2.1 and Figure A2.2 for 2026 and 2036 respectively.

A2.5 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

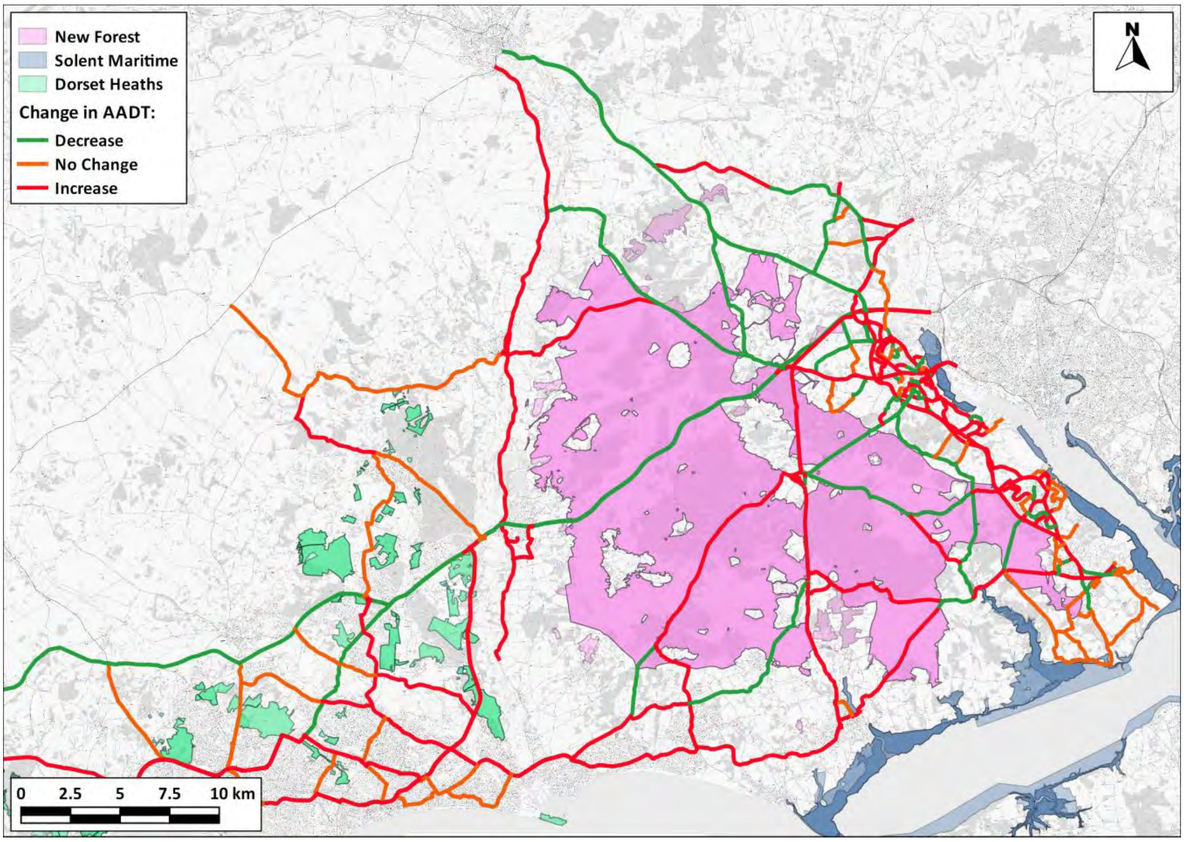

Figure A2.1: Modelled Road Network and Changes in AADT Flows between Do-Minimum and Do-Something Scenarios for 2026

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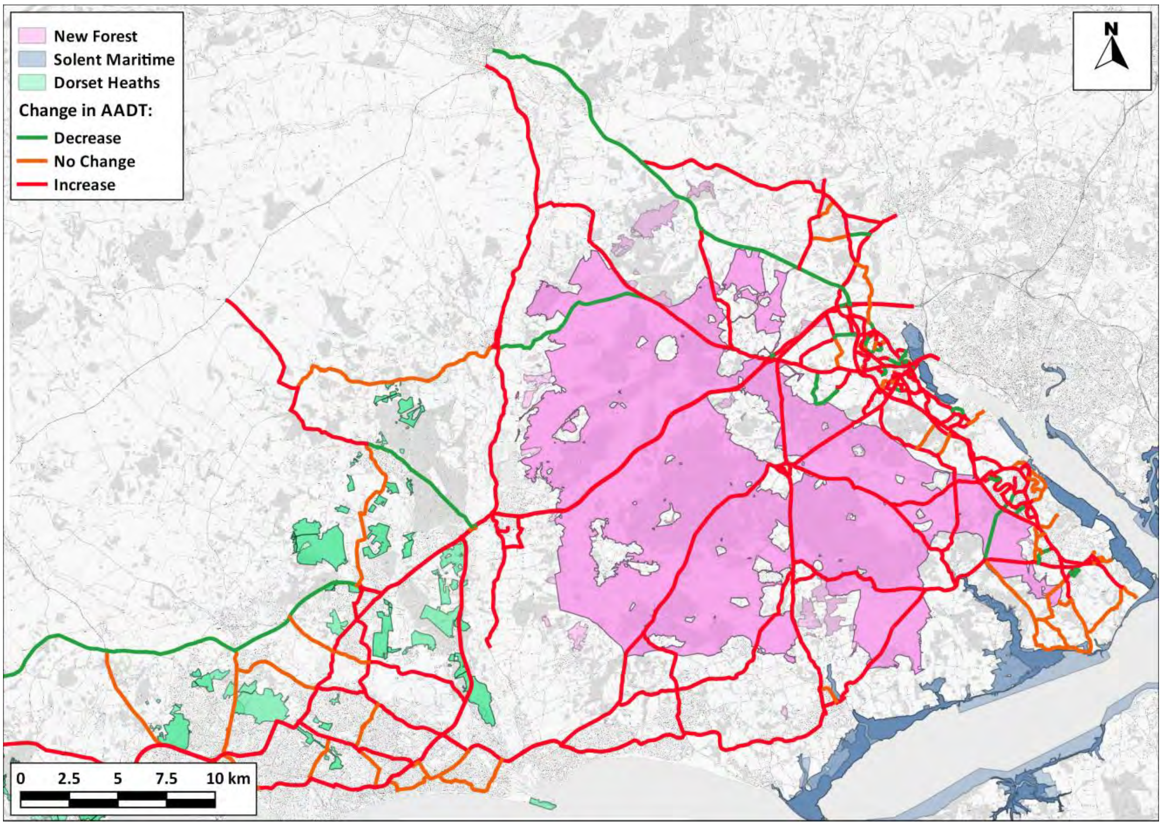

Figure A2.2: Modelled Road Network and Changes in AADT Flows between Do-Minimum and Do-Something Scenarios for 2026

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Sensitivity Test for NOx and Nitrogen Dioxide

A2.6 As explained in Paragraph 3.18 AQC has carried out a detailed analysis which showed that, where previous standards had limited on-road success in reducing NOx emissions from diesel vehicles, the 'Euro VI' and 'Euro 6' standards are delivering real on-road improvements (AQC, 2016b). Furthermore, these improvements are expected to increase as the Euro 6 standard is fully implemented. Despite this, the detailed analysis suggested that, in addition to modelling using the EFT (V7.0), a sensitivity test using elevated NOx emissions from certain diesel vehicles should be carried out (AQC, 2016b). A sensitivity test has thus been carried out by applying the adjustments set out in Table A2.2 to the emission factors used within the EFT[10], using AQC's CURED (V2A) tool (AQC, 2016a). The justifications for these adjustments are given in AQC (2016b). Results are thus presented for three scenarios: first the 'official prediction', which uses the EFT with no adjustment, the second the 'sensitivity test', which applies the adjustments set out in Table A2.2 and the third 'worst-case' which assumes that road traffic emissions are held constant at 2015

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[10] All adjustments were applied to the COPERT functions. Fleet compositions etc. were applied following the same methodology as used within the EFT.

levels. The results from the sensitivity test and worst-case scenario are likely to over-predict emissions from vehicles in the future.

Table A2.2: Summary of Adjustments Made to Defra's EFT (V7.0)

Vehicle Type		Adjustment Applied to Emission Factors
All Petrol Vehicles		No adjustment
Light Duty Diesel Vehicles	**Euro 5 and earlier**	No adjustment
	Euro 6	Increased by 78%
Heavy Duty Diesel Vehicles	**Euro III and earlier**	No adjustment
	Euro IV and V	Set to equal Euro III values
	Euro VI	Set to equal 20% of Euro III emissions [a]

[a] Taking account of the speed-emission curves for different Euro classes as explained in AQC (2016b).

Background Concentrations

A2.7 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030. The background maps for 2015 have been calibrated against concurrent measurements from national monitoring sites. The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted concentrations for the future assessment year than that derived from the Defra maps (AQC, 2016c).

Background NO_2 and NO_x Concentrations for Sensitivity Test

A2.8 The road-traffic components of NOx and nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide and NOx concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2016c).

Background Nutrient-Nitrogen Deposition

A2.9 Total nutrient-nitrogen deposition comprises both reduced and oxidised nitrogen elements. Background total nutrient-nitrogen deposition has been taken from the UK Deposition data provided by the Centre for Ecology and Hydrology (Centre for Ecology and Hydrology, 2017). The approach described in Section 3 has been used to factor the latest available background concentrations in 2014 forward to 2026 and 2036.

Background Ammonia Concentrations

A2.10 The background pollutant concentrations across the study area have been taken from UK Deposition data provided by the Centre for Ecology and Hydrology (Centre for Ecology and Hydrology, 2017). These cover the whole country on a 5 x 5 km grid and are published yearly from

2004 until 2014. Since data for 2015 are not available, the values for 2014 have been used for projecting the backgrounds forward to future assessment years.

A2.11 It is difficult to predict how emissions of ammonia from road traffic might change between 2015 and 2036. In order to factor background ammonia concentrations from the modelled base year (2015) to the future years, Defra's national emissions projections have been used. There is no reason to expect local trends to be very different to those expected on a national scale. The national emissions projections estimate total ammonia concentrations to increase from 272.11 kt in 2015 to 294.33 kt in 2030. The ratio of the base year total emission (2015) to the future year total emission (2026 or 2030) has been applied to the latest available background concentration in 2014 for each 5 x 5 km grid square.

Model Verification

A2.12 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

A2.13 The 2015 background concentrations have been derived from the national maps, having been calculated using the same approach as described in Paragraph A2.7. The background concentration for the verification site is presented in Table A2.3.

Table A2.3: Background Concentrations used in the Verification for 2015

Year	NO_2
2015	9.6 – 18.9
Objectives	**40**

Traffic Data

A2.14 The same traffic data, including AADT flows and the proportions of HDVs, as described in Paragraph A2.3 have been used in the model verification. These are available upon request.

Nitrogen Dioxide

A2.15 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of NOx ($NO_x = NO + NO_2$). The model has been run to predict the annual mean NOx concentrations during 2015 at all modelling sites within Lyndhurst, as well as at Site 32 (adjacent to the A31), Site 34 (adjacent to Normandy Way) and Site 36 (adjacent to Marchwood By-pass). Where it has been possible to locate the monitoring site, concentrations have been modelled at a height deemed reasonable by judgement. At locations where it has not been possible to locate the monitoring site, the height provided in the 2016 Annual Status Report has been used for that monitor.

A2.16 The model output of road-NO_x (i.e. the component of total NO_x coming from road traffic) has been compared with the 'measured' road-NO_x. Measured road-NO_x has been calculated from the measured NO_2 concentration and the predicted background NO_2 concentration using the NO_x from NO_2 calculator (Version 5.1) available on the Defra LAQM Support website (Defra, 2017a).

A2.17 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A2.4). The calculated adjustment factor of 2.9141 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A2.18 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A2.4 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

A2.19 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

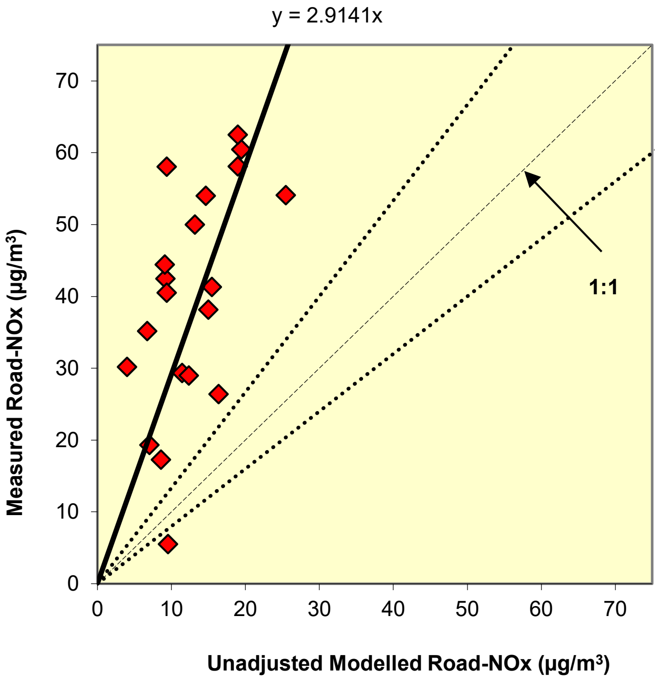

Figure A2.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

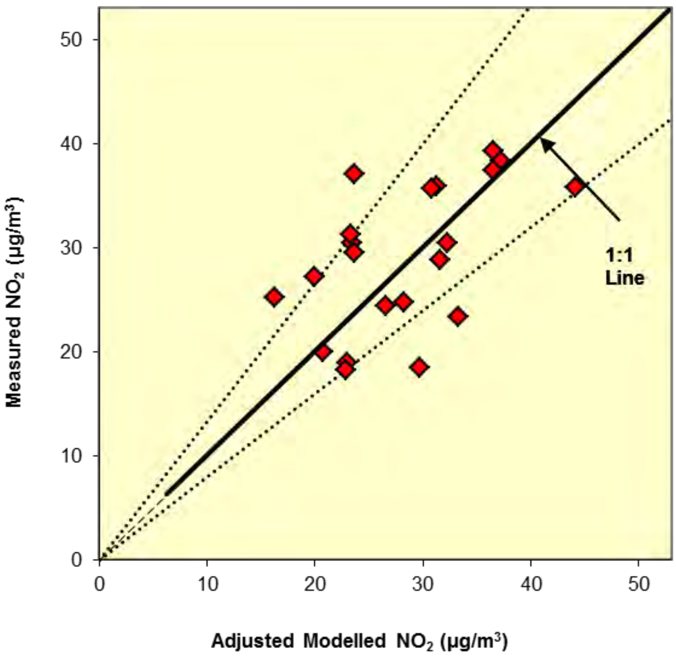

Figure A2.4: **Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.**

Model Verification for NO_x and NO_2 Sensitivity Test

A2.20 The approach set out above has been repeated using the predicted road- NO_x specific to the sensitivity test. This has resulted in an adjustment factor of 2.6616, this implies that the unadjusted model is under-predicting the road-NO_x contribution.

Verification Site Locations

A2.21 It is important to highlight that the roads adjacent to the verification sites in Lyndhurst are not wholly representative of the roads passing through the ecological areas where impacts have been assessed. Monitoring carried out by New Forest District Council is concentrated in the towns of Lyndhurst and Totton, with few sites along major roads passing through the designated ecological areas. The High Street, the main road through Lyndhurst, and along which the majority of monitoring locations used in the verification are situated, exhibits canyon like features, formed by tall buildings on either side of the narrow road, where vehicle speeds are likely to be slow from congestion. Monitoring site 32, located at Stoney Cross, is adjacent to the A31 where vehicle flows will be less congested and dispersion will occur more freely, however, the site is 20 m from the roadside. Sites 34 and 36 are also set back from the roadside; however the adjacent roads will carry faster moving traffic, in a better environment for dispersion, than those in Lyndhurst. Despite these differences in setting, there is no observed systematic difference between the performance of the model in these urban and non-urban settings. It is thus considered appropriate to verify the model against a combination of sites in Lyndhurst and those beside free-flowing roads. A model is considered to be performing well if the majority of predictions are within ±25% of the measurement (the dotted lines in Figure A2.4). Whilst there are several points outside of the 25% banding, there is no defensible reason, such as local phenomena influencing local concentrations, to remove these from the verification process.

A2.22 Despite a root mean square error of 6.5 $\mu g/m^3$ (4 $\mu g/m^3$ is recommended in LAQM TG16), considering the available monitoring locations, it is not thought that iterations to the model setup; which would principally involve the roads in urban areas, would improve the model verification, and therefore no further iterations to the model were completed.

Model Post-processing

Road Traffic

NOx and nitrogen dioxide

A2.23 The model predicts road- NO_x 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 NO_x to NO_2 calculator available on the Defra LAQM Support website (Defra, 2017a). The traffic mix within the calculator has been set to “All other urban UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road- NO_x and the background NO_2.

Deposition Rates

A2.24 Deposition has not been included within the dispersion model because a key depositing component of concern is nitrogen dioxide and this is calculated from NOx outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations using the deposition velocities set out in Table A2.4. 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 ($\mu g/m^3$) by the velocity (m/s) to predict a deposition flux ($\mu g/m^2/s$). Subsequent calculations required to present the data as kg/ha/yr of nitrogen or sulphur and as keq/ha/yr for acidity follow basic chemical and mathematical rules[11].

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[11] For example, 1 kg N/ha/yr = 0.071 keq/ha/yr

Table A2.4: Deposition Velocities for Nitrogen Dioxide Used in This Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Nitrogen Dioxide	0.0015 (Grassland)	AQTAG06 (Environment Agency, 2011)
	0.003 (Forest)	AQTAG06 (Environment Agency, 2011)

A2.25 Wet deposition has been discounted. Wet deposition of the emitted pollutants this 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. The low solubility of nitrogen dioxide means that any scavenging of this gas will be a negligible factor. While wash-out of sulphur dioxide might be more significant, the very low sulphur oxide emission rates mean that discounting wet deposition is highly unlikely to affect the outcomes of the assessment.

Ammonia Concentrations

A2.26 Ammonia and NOx are primary pollutants from road traffic; and therefore it follows that there exists a relationship between predicted road-NOx concentrations (from the calibrated model) and ambient ammonia concentrations. A recent study (AQC, 2017) demonstrated that in 2015, for each gramme of NOx emitted, 0.0205 grammes of ammonia are also assumed to be emitted (although the processes which emit NOx and ammonia are slightly different). The equivalent value for future years is assumed to be 0.029991. Verified Road-NOx concentrations have thus been multiplied by the correct factor in order to calculate the ammonia concentration.

A3 Contour Figures

2026 Do Something

Annual Mean NOx

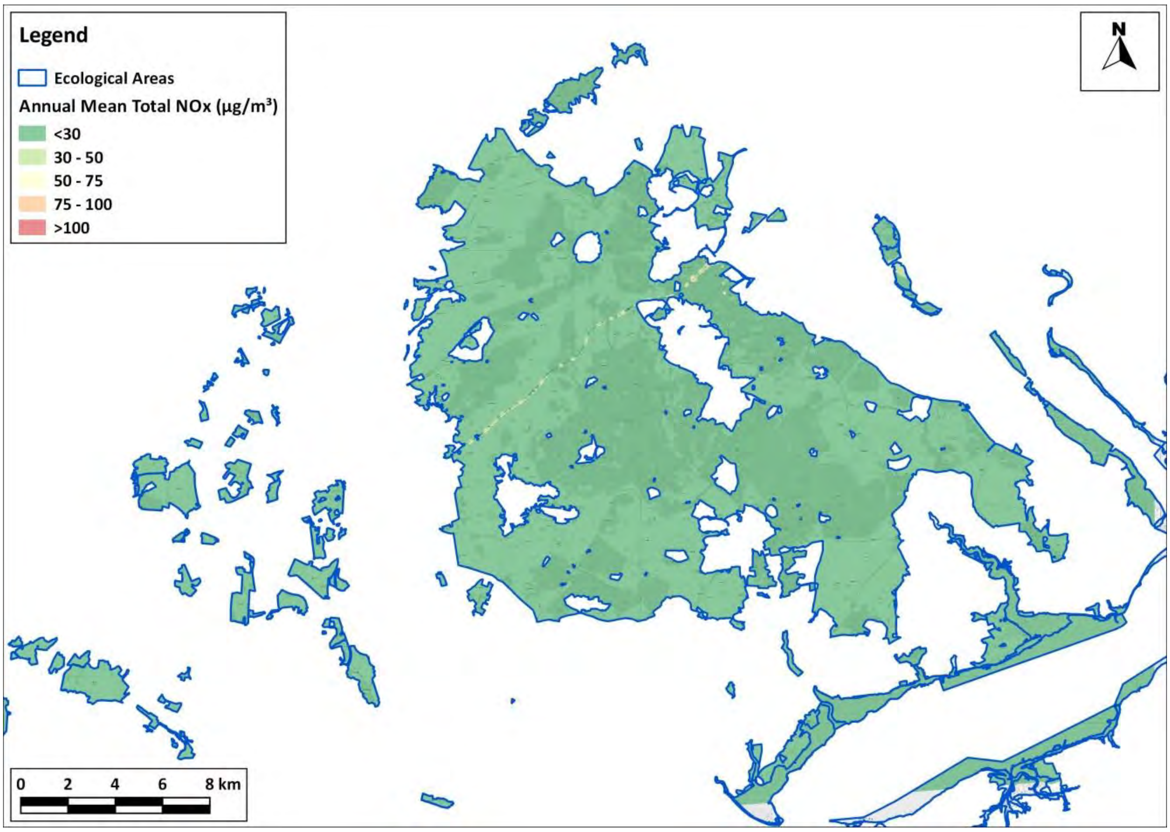

Figure A3.1: 2026 Total Annual Mean NOx Concentrations

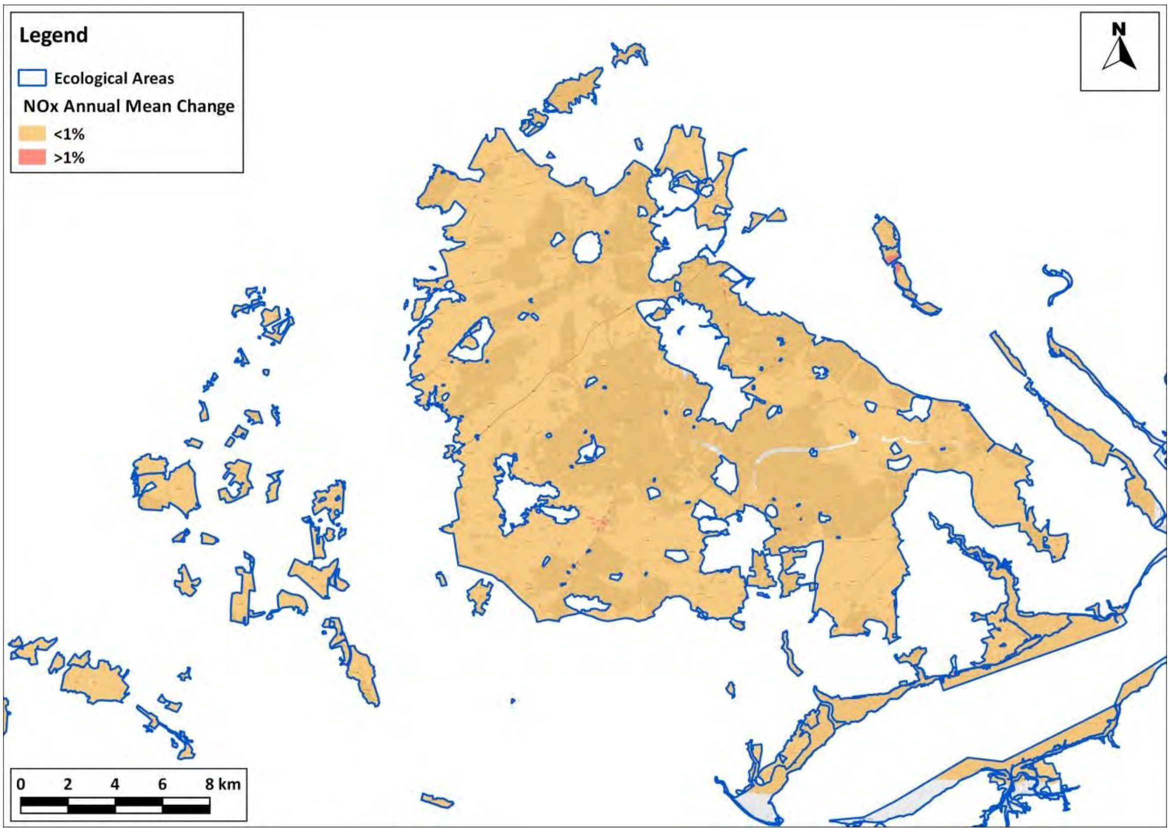

Figure A3.2: 2026 Annual Mean NOx Percentage Change

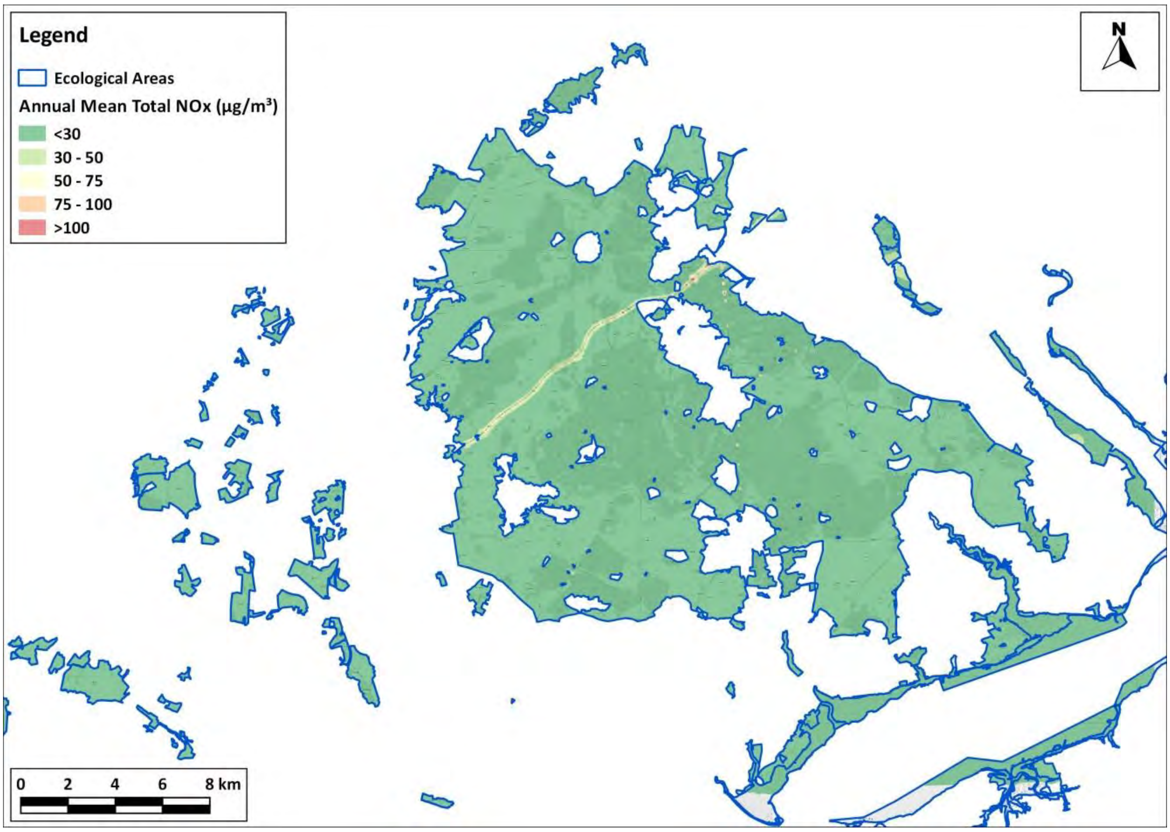

Figure A3.3: 2026 Total Annual Mean NOx Concentrations based on Sensitivity Test

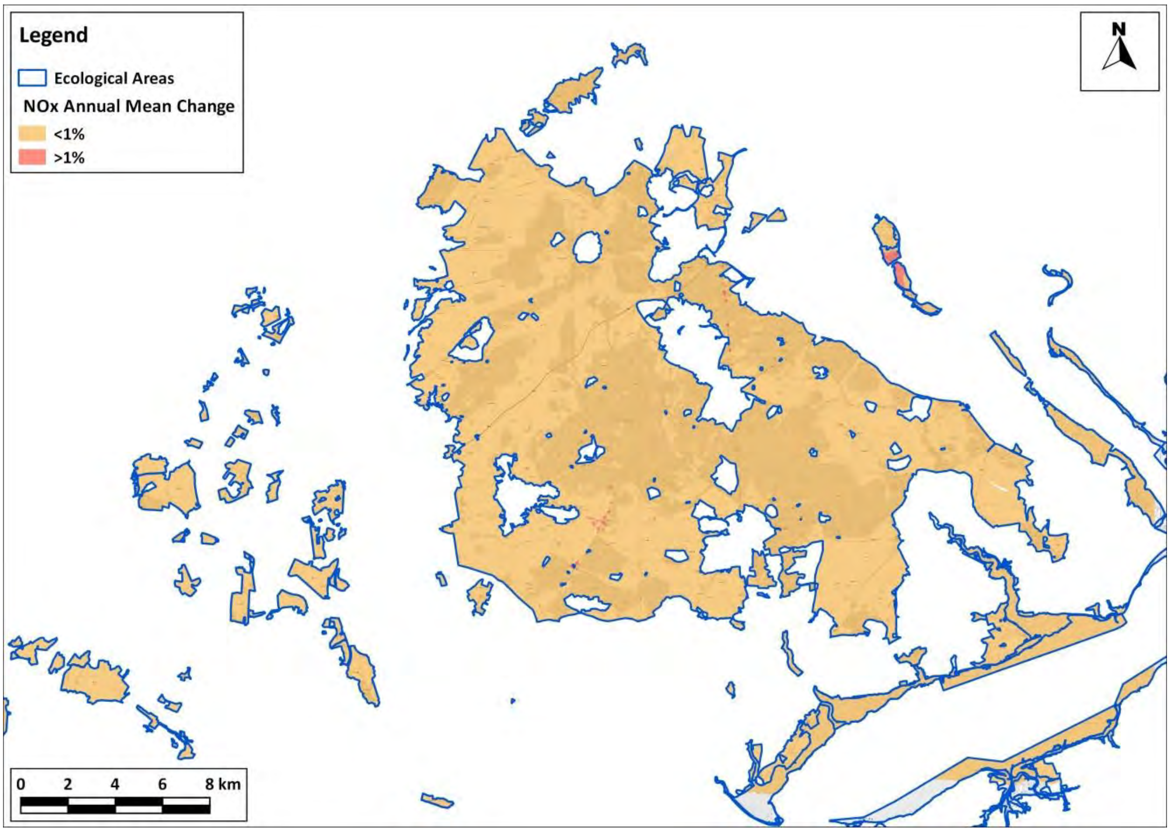

Figure A3.4: 2026 Annual Mean NOx Percentage Change based on Sensitivity Test

24-Hour NOx

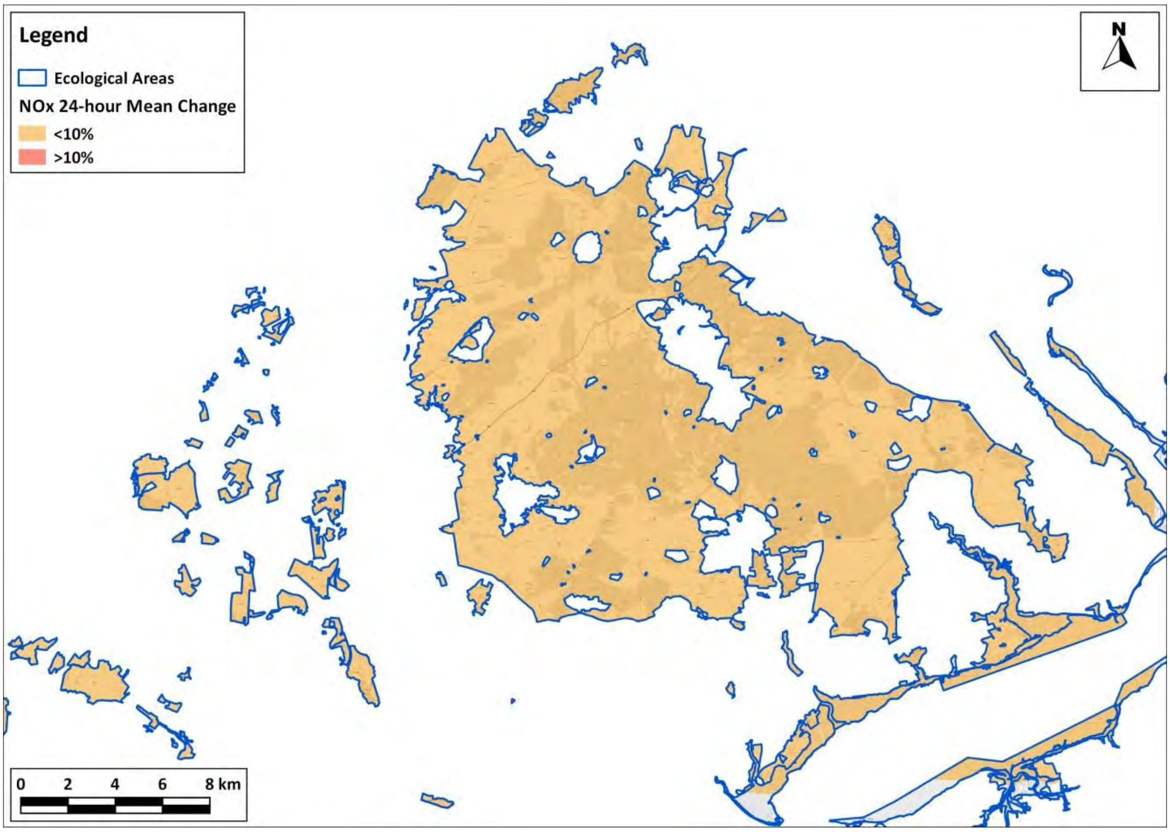

Figure A3.5: 2026 24-Hour NOx Percentage Change

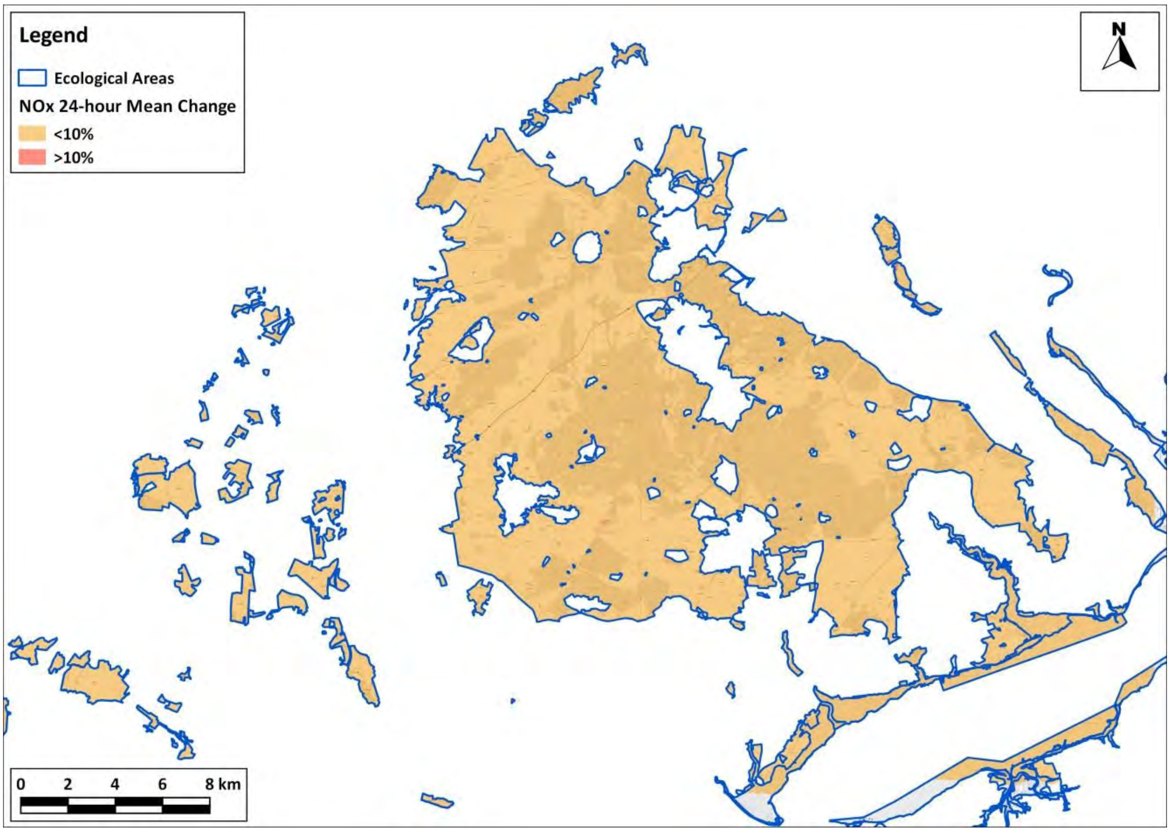

Figure A3.6: 2026 24-Hour NOx Percentage Change based on Sensitivity Test

Annual Mean Ammonia

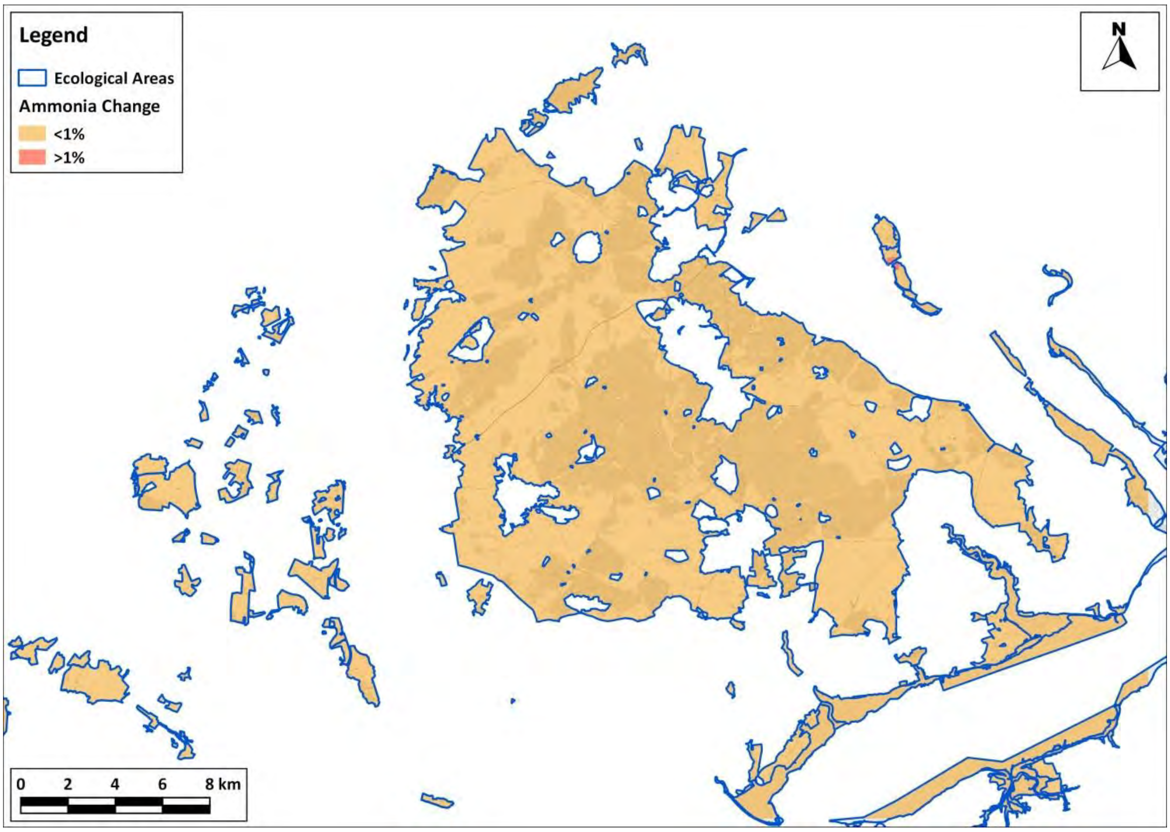

Figure A3.7: 2026 Annual Mean Ammonia Percentage Change

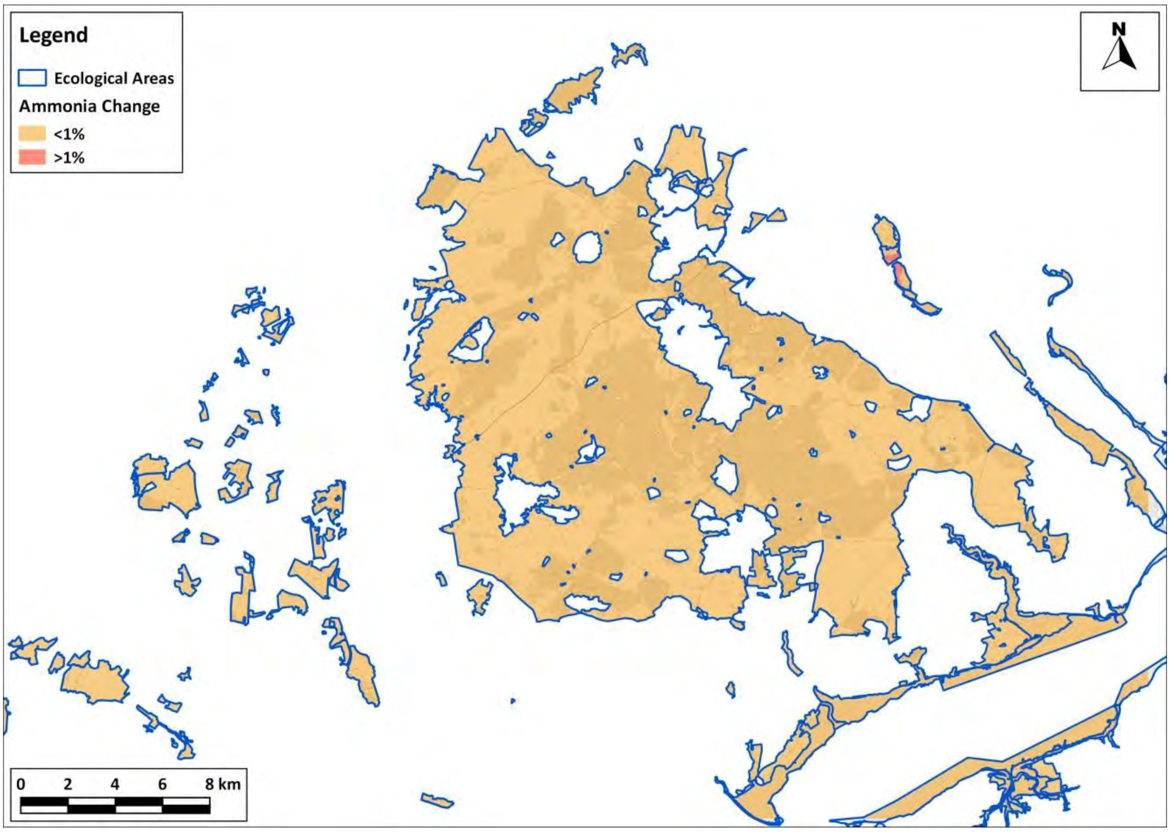

Figure A3.8: 2026 Annual Mean Ammonia Percentage Change based on Sensitivity Test

Nutrient Nitrogen Deposition

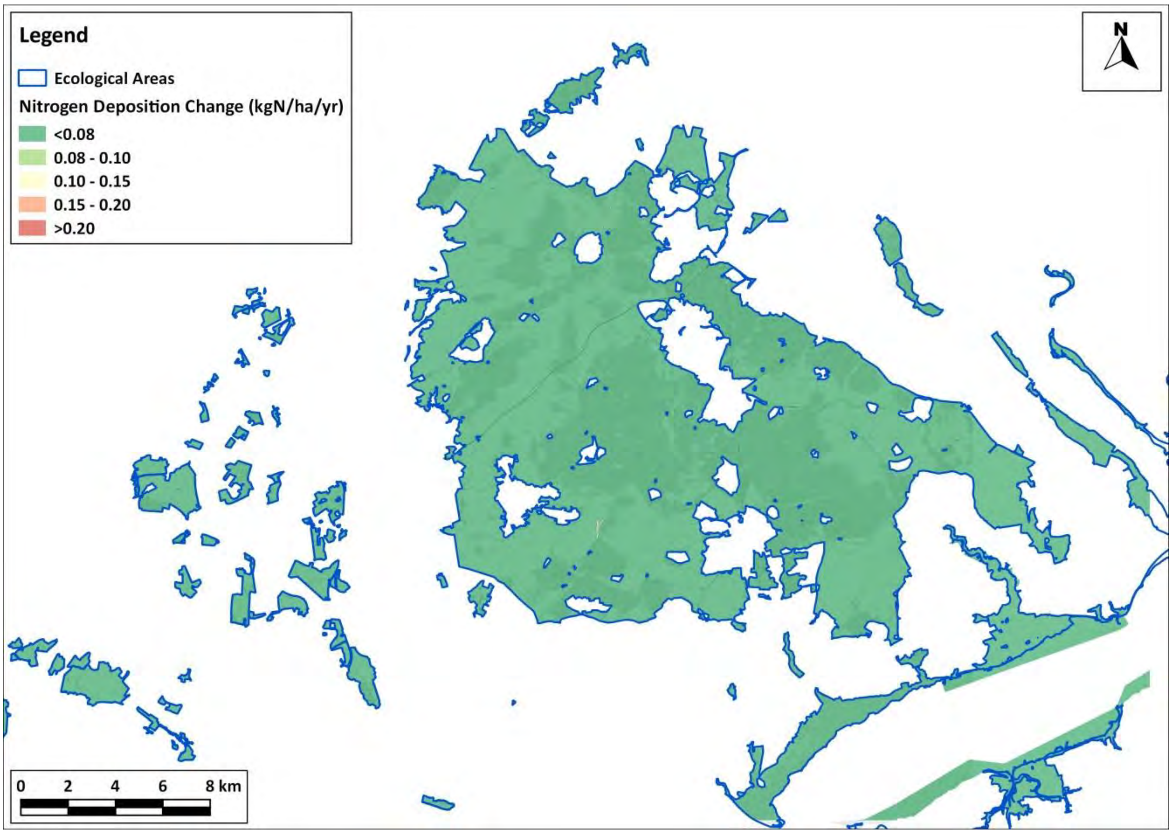

Figure A3.9: 2026 Nutrient Nitrogen Deposition Absolute Change

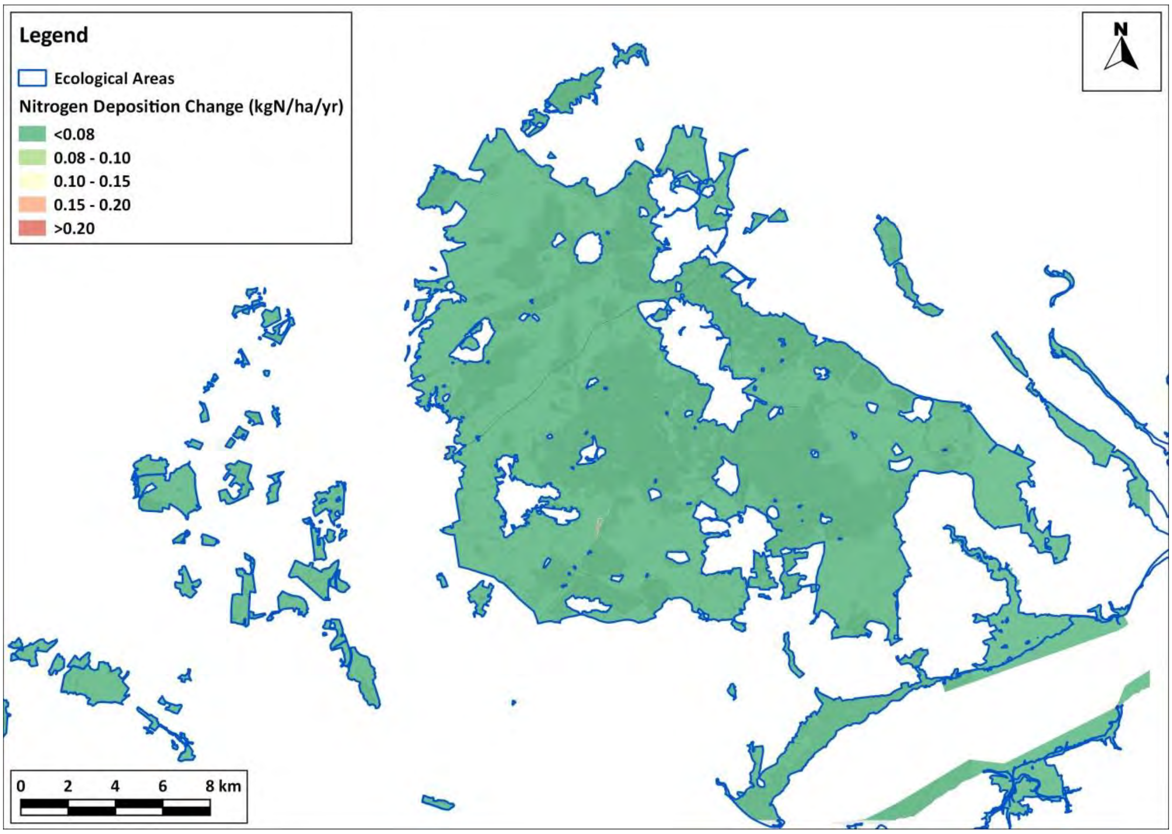

Figure A3.10: 2026 Nutrient Nitrogen Deposition Absolute Change based on Sensitivity Test

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2036 Do Something

Annual Mean NOx

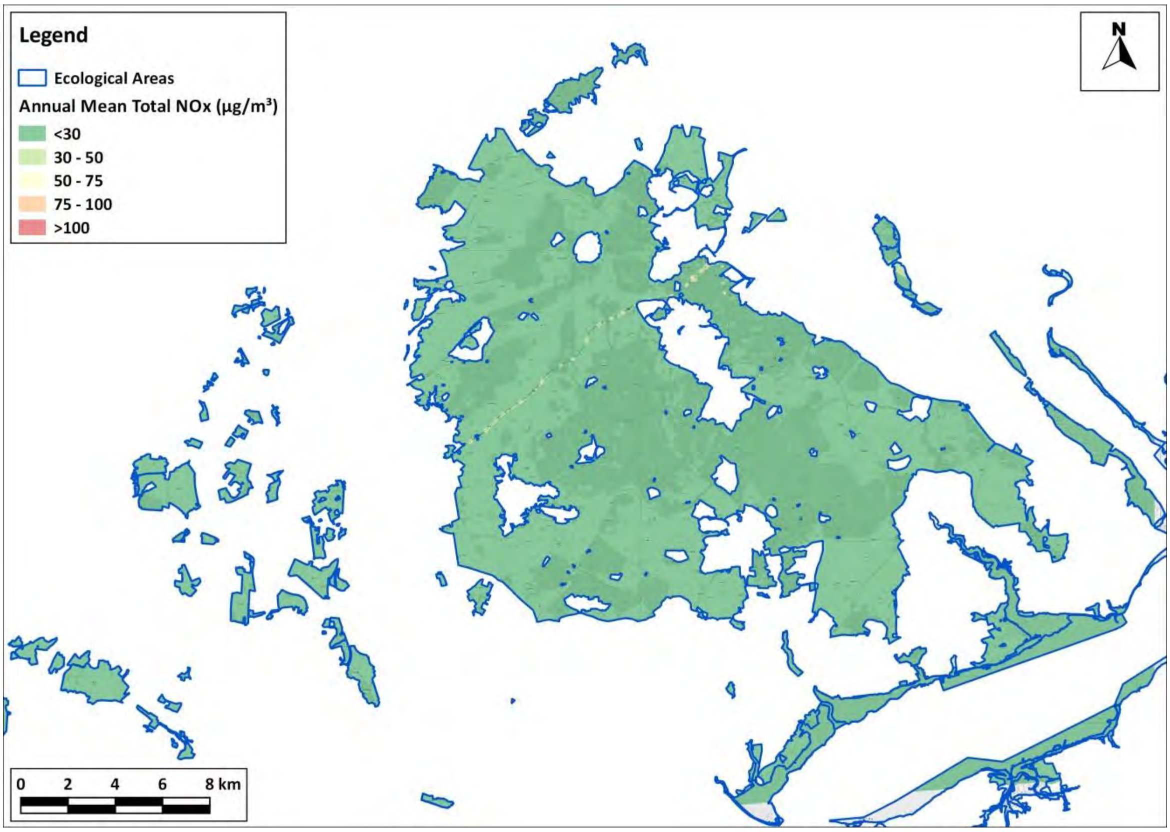

Figure A3.11: 2036 Total Annual Mean NOx Concentrations

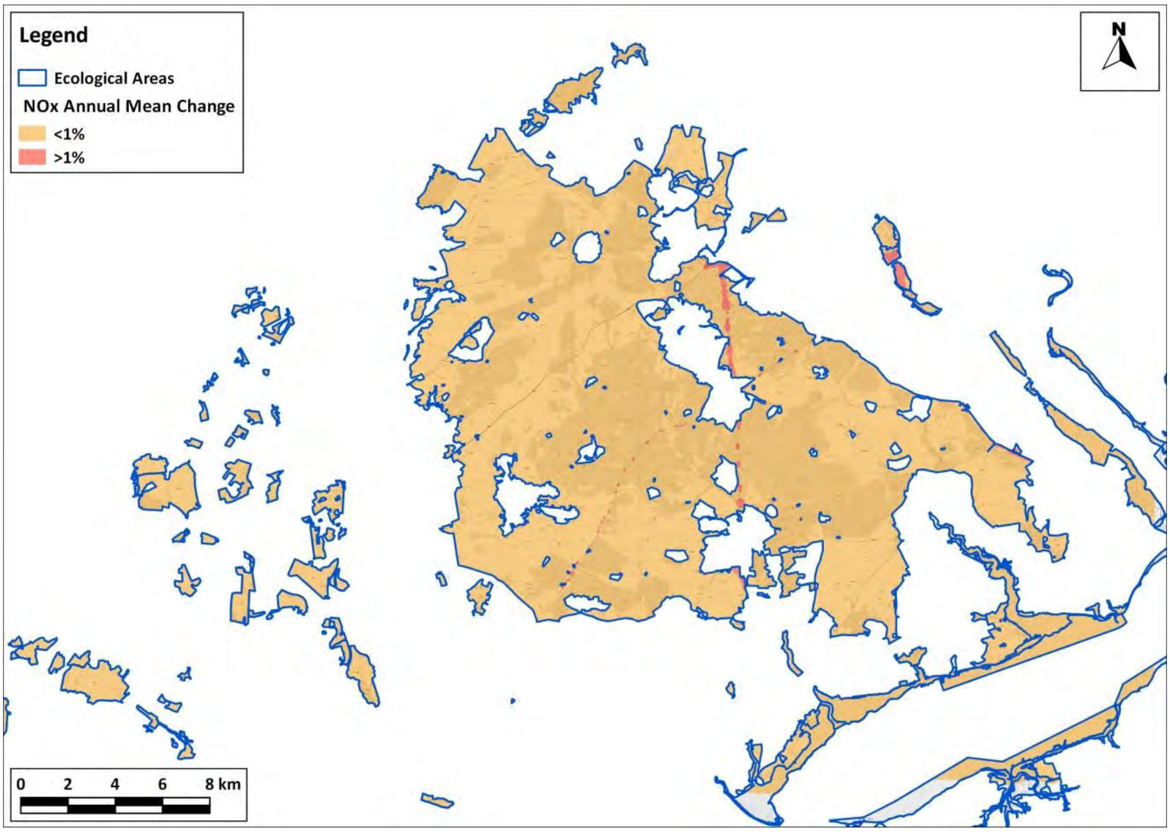

Figure A3.12: 2036 Annual Mean NOx Percentage Change

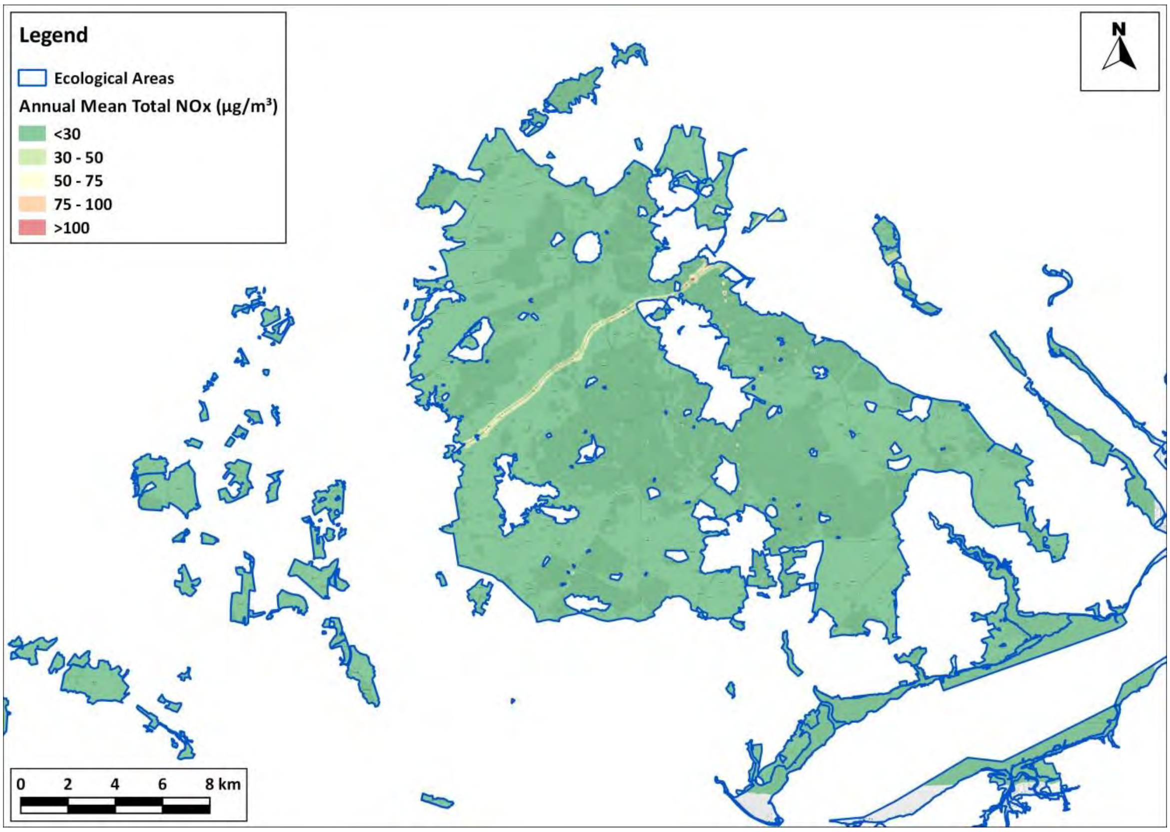

Figure A3.13: 2036 Total Annual Mean NOx Concentrations based on Sensitivity Test

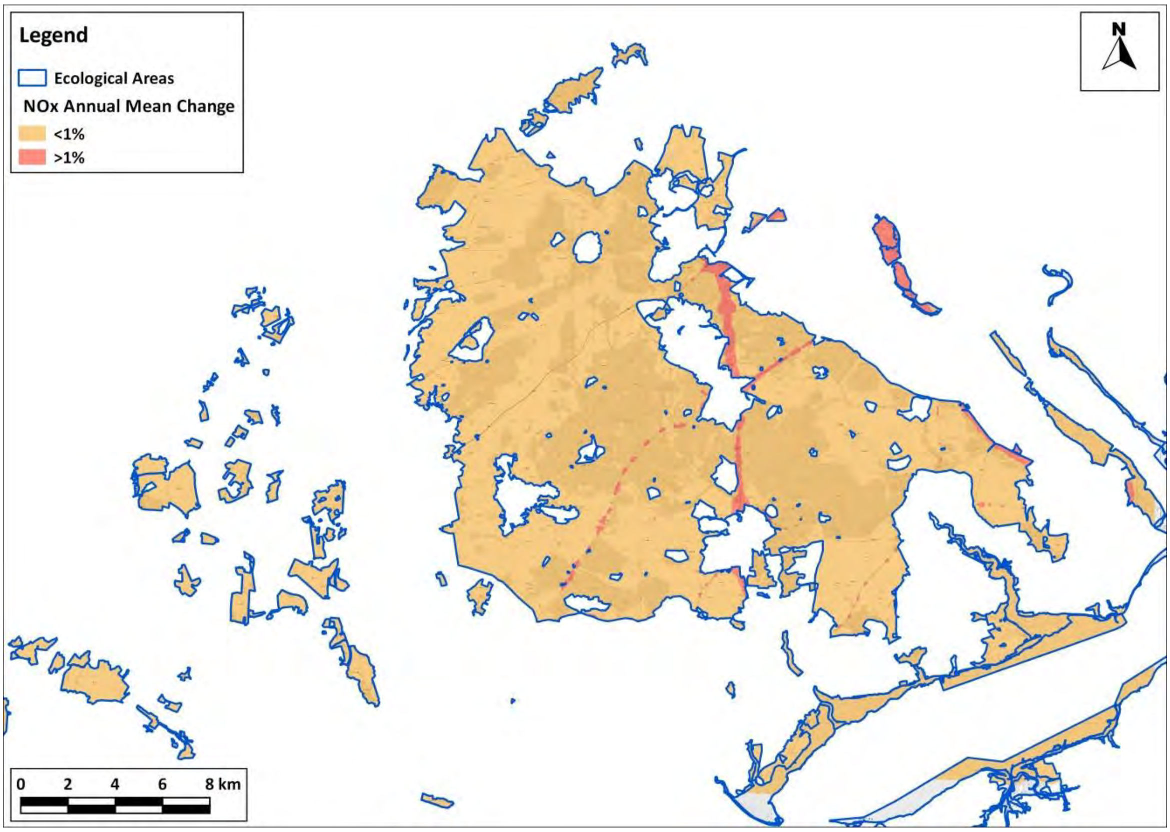

Figure A3.14: 2036 Annual Mean NOx Percentage Change based on Sensitivity Test

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24-Hour NOx

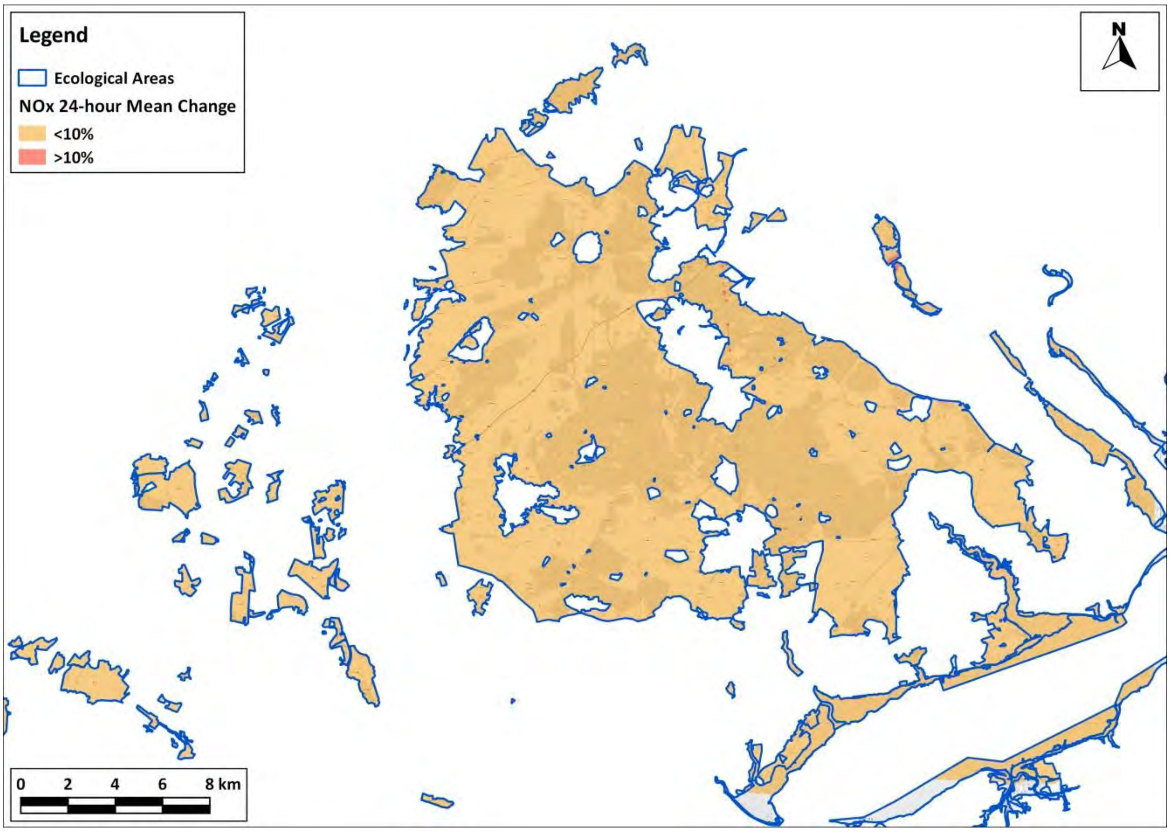

Figure A3.15: 2036 24-Hour NOx Percentage Change

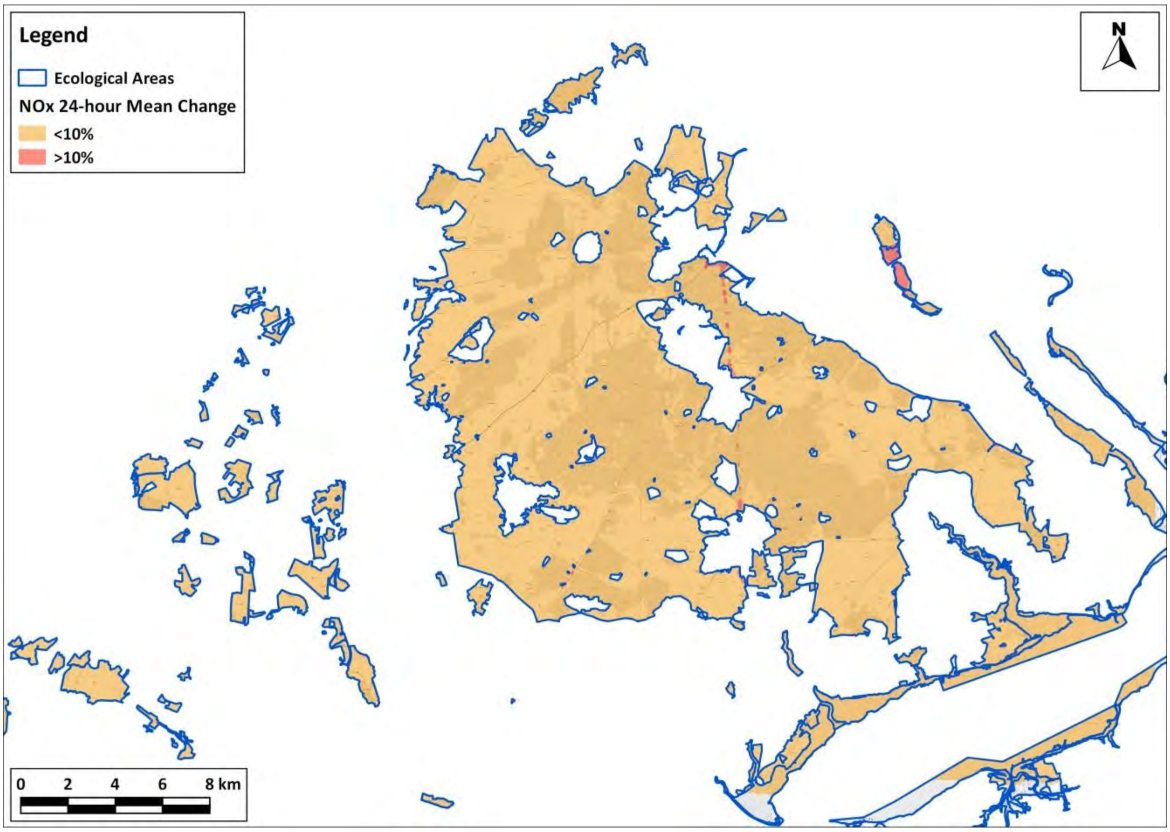

Figure A3.16: 2036 24-Hour NOx Percentage Change based on Sensitivity Test

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Annual Mean Ammonia

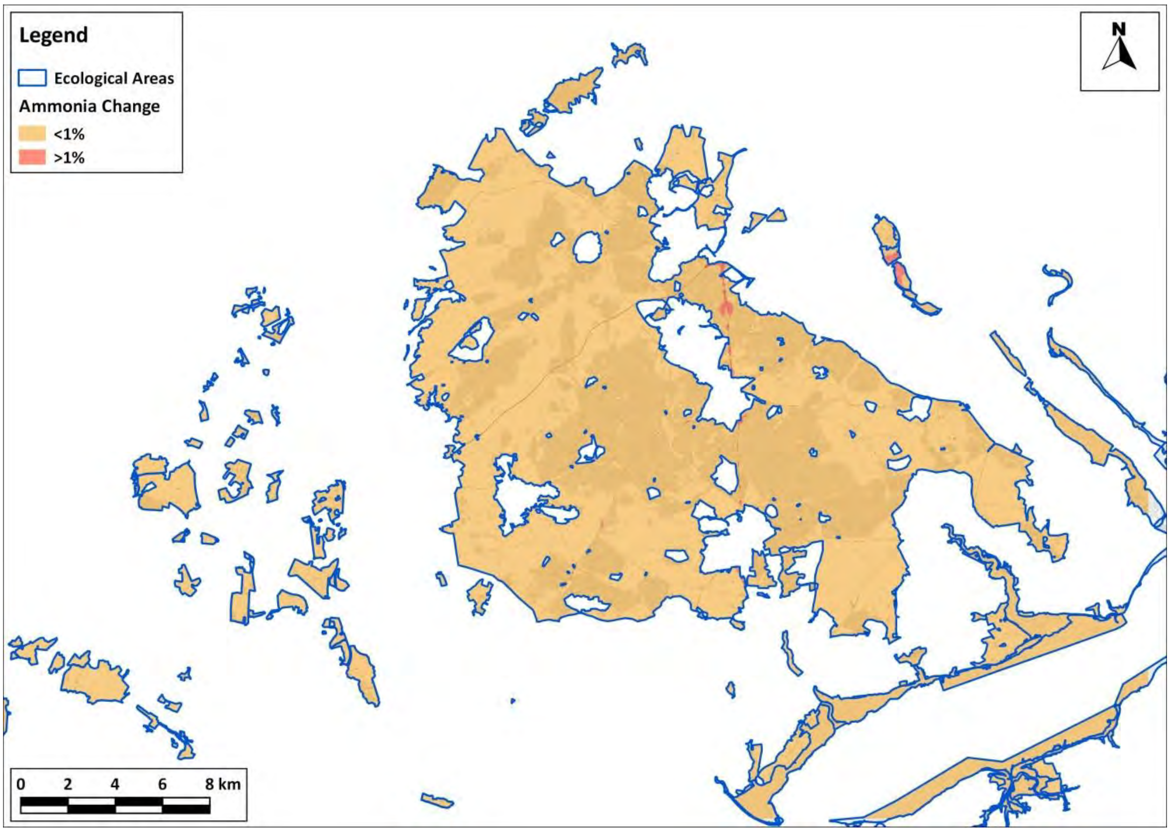

Figure A3.17: 2036 Annual Mean Ammonia Percentage Change

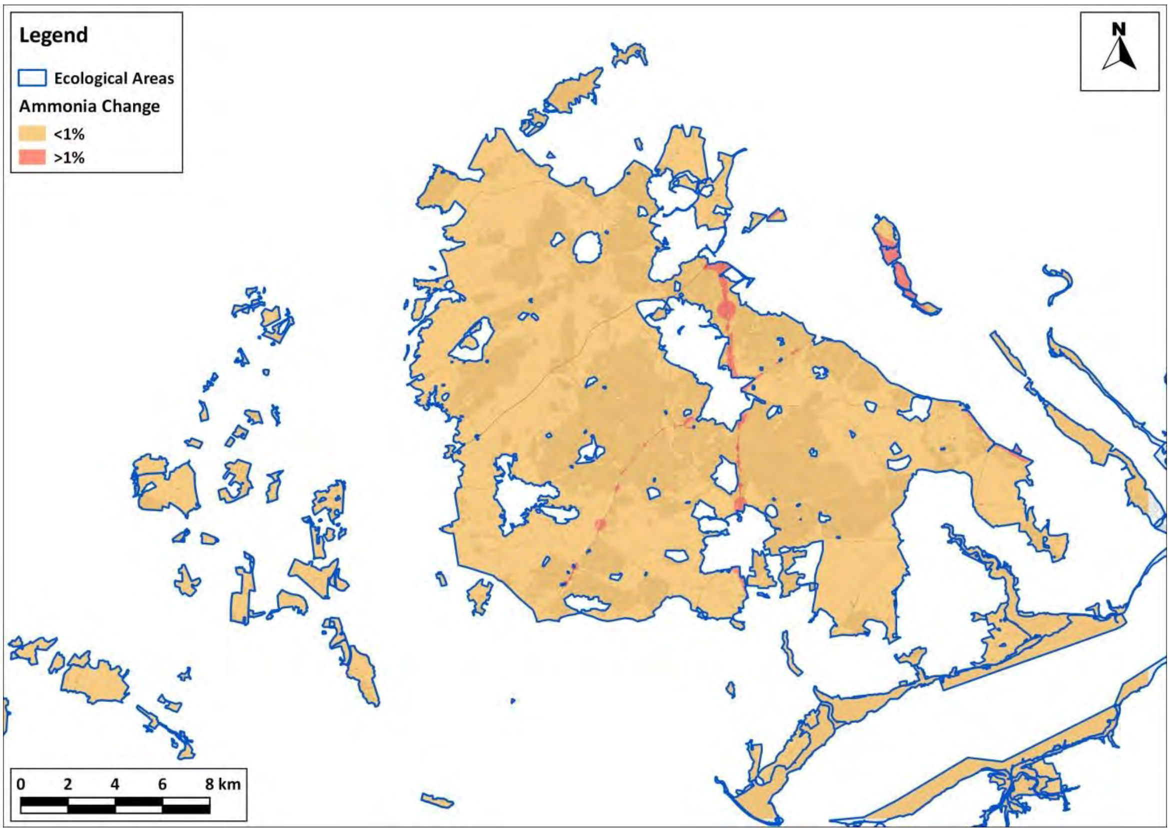

Figure A3.18: 2036 Annual Mean Ammonia Percentage Change based on Sensitivity Test

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Nutrient Nitrogen Deposition

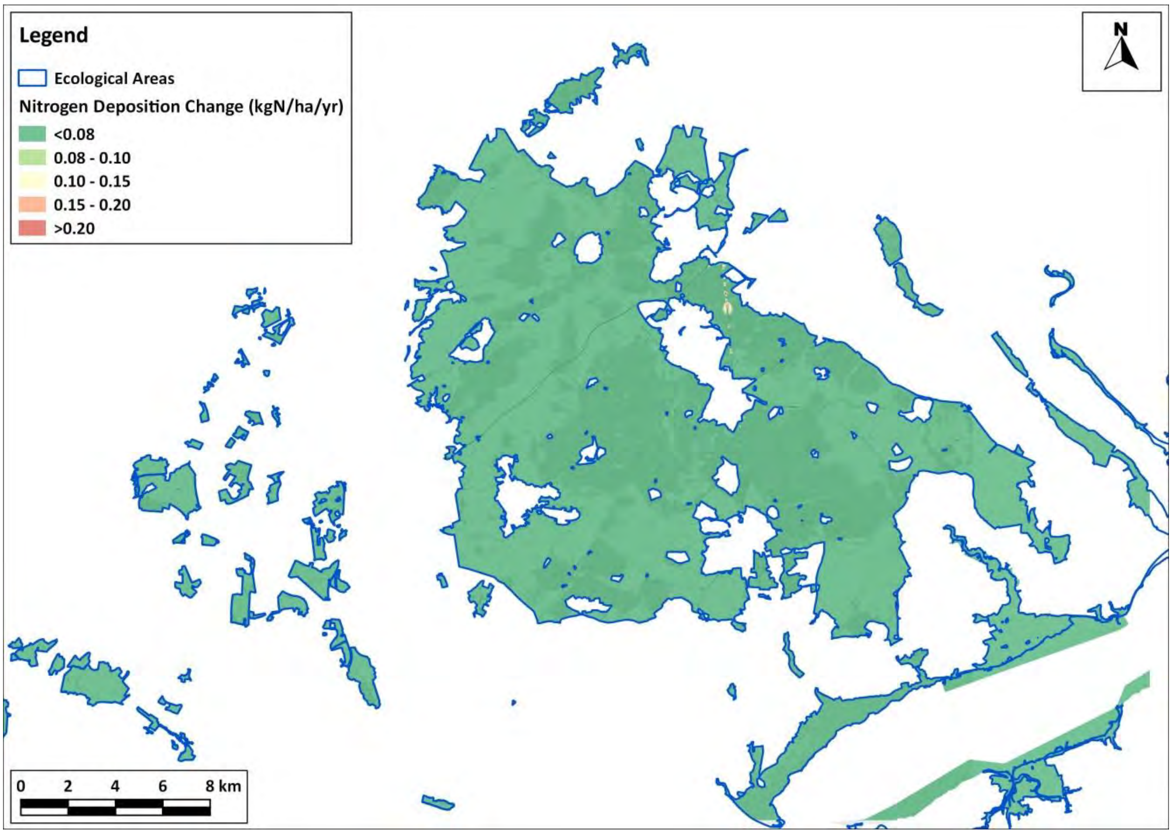

Figure A3.19: 2036 Nutrient Nitrogen Deposition Absolute Change

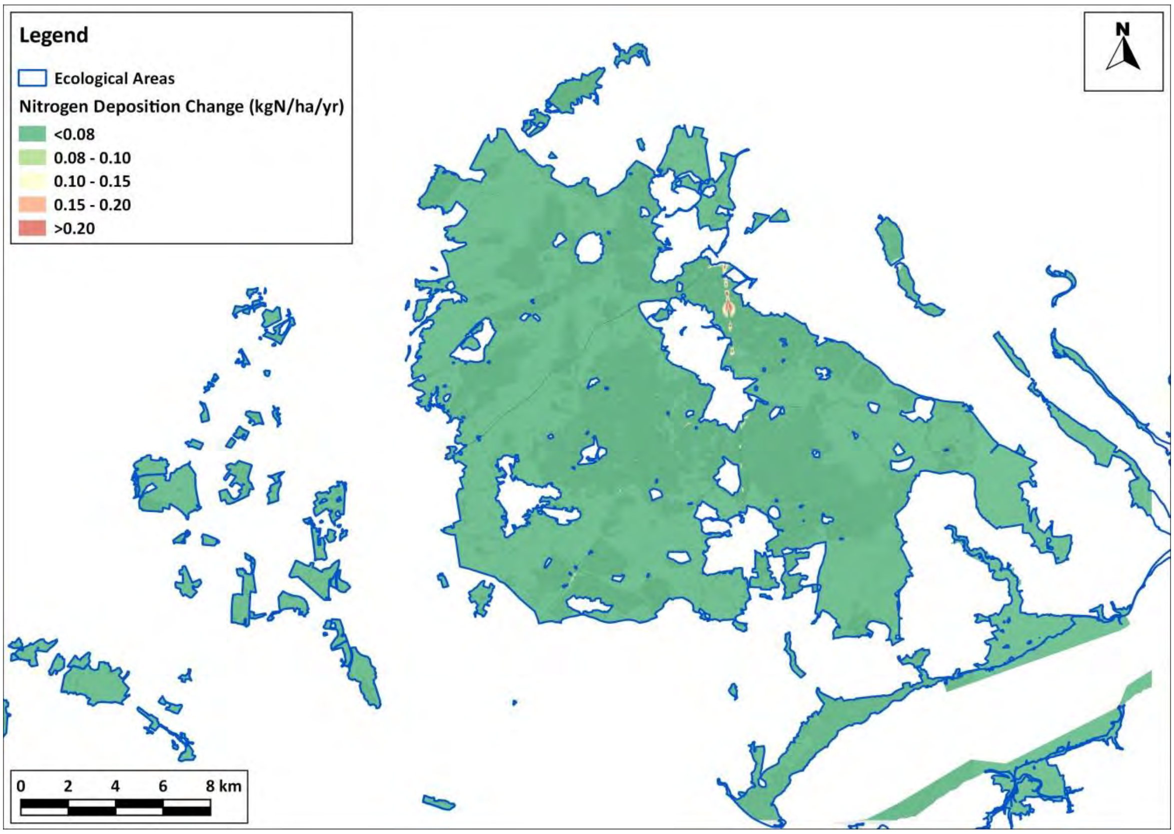

Figure A3.20: 2036 Nutrient Nitrogen Deposition Absolute Change based on Sensitivity Test

2026 In-Combination

Annual Mean NOx

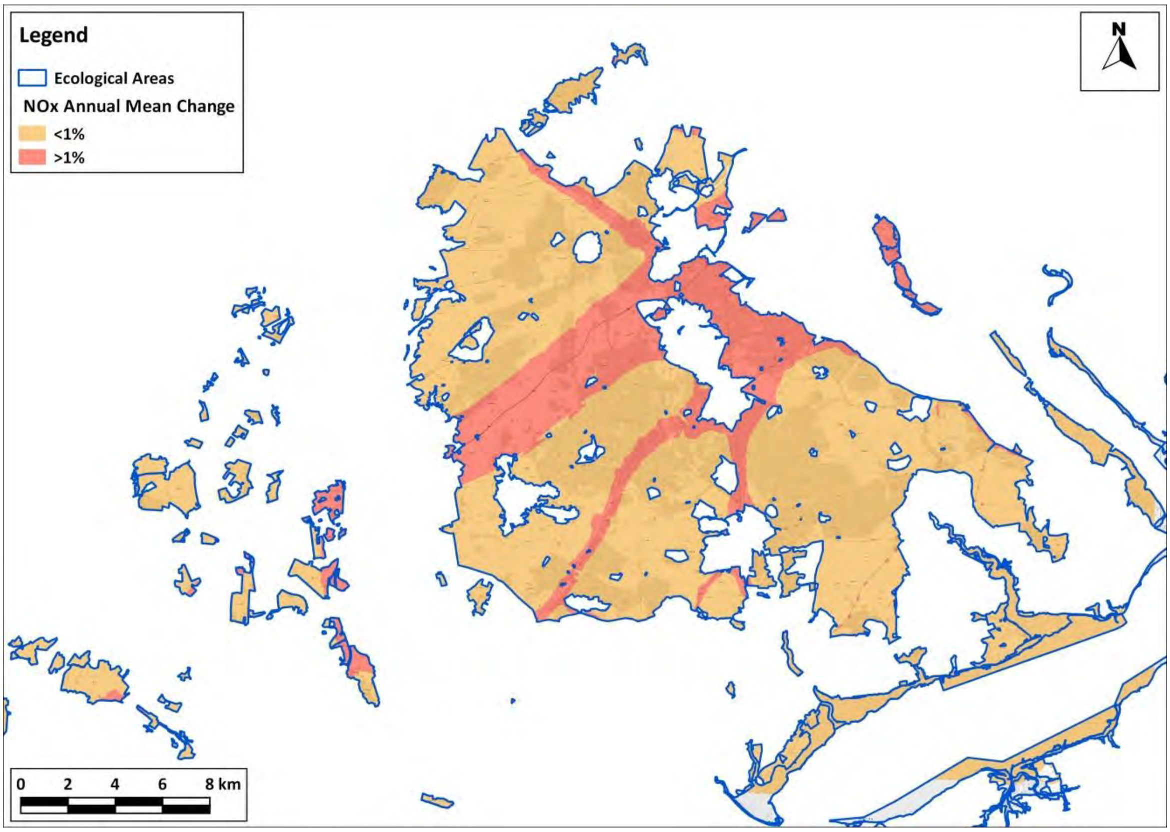

Figure A3.21: 2026 In-Combination Annual Mean NOx Percentage Change

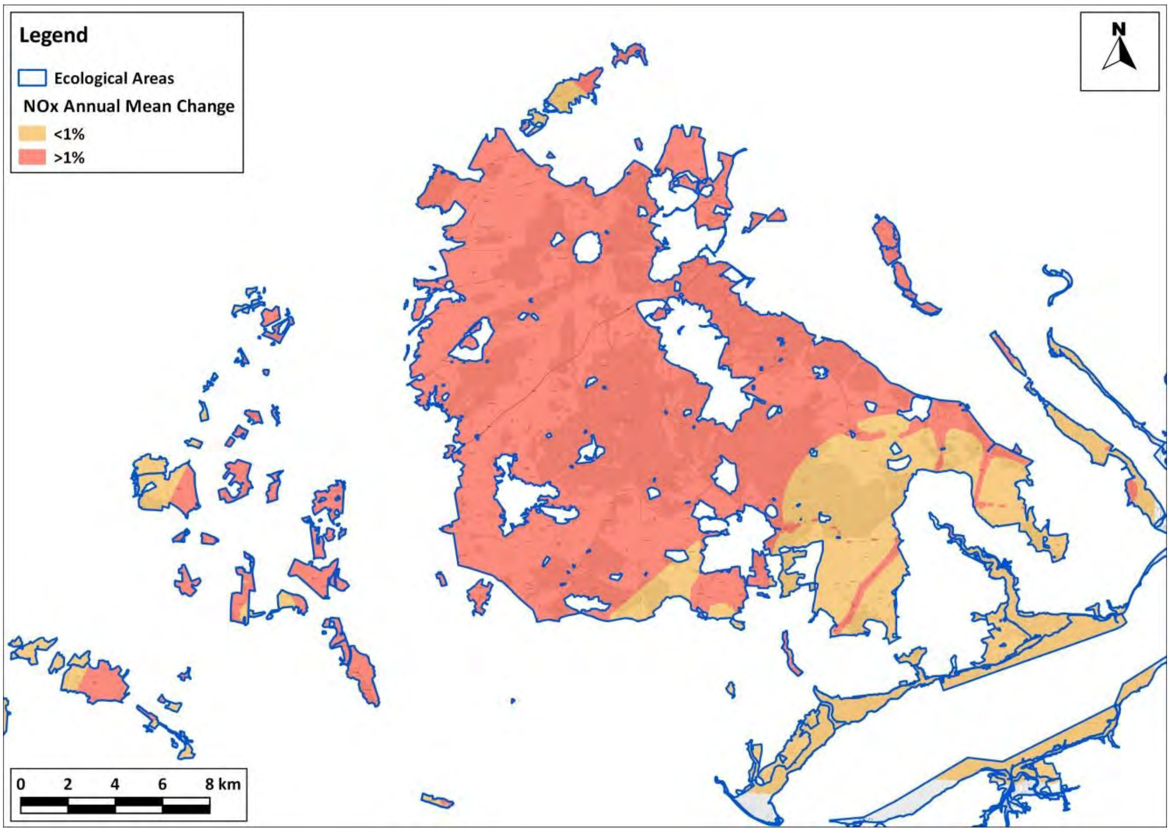

Figure A3.22: 2026 In-Combination Annual Mean NOx Percentage Change Sensitivity Test

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24-Hour NOx

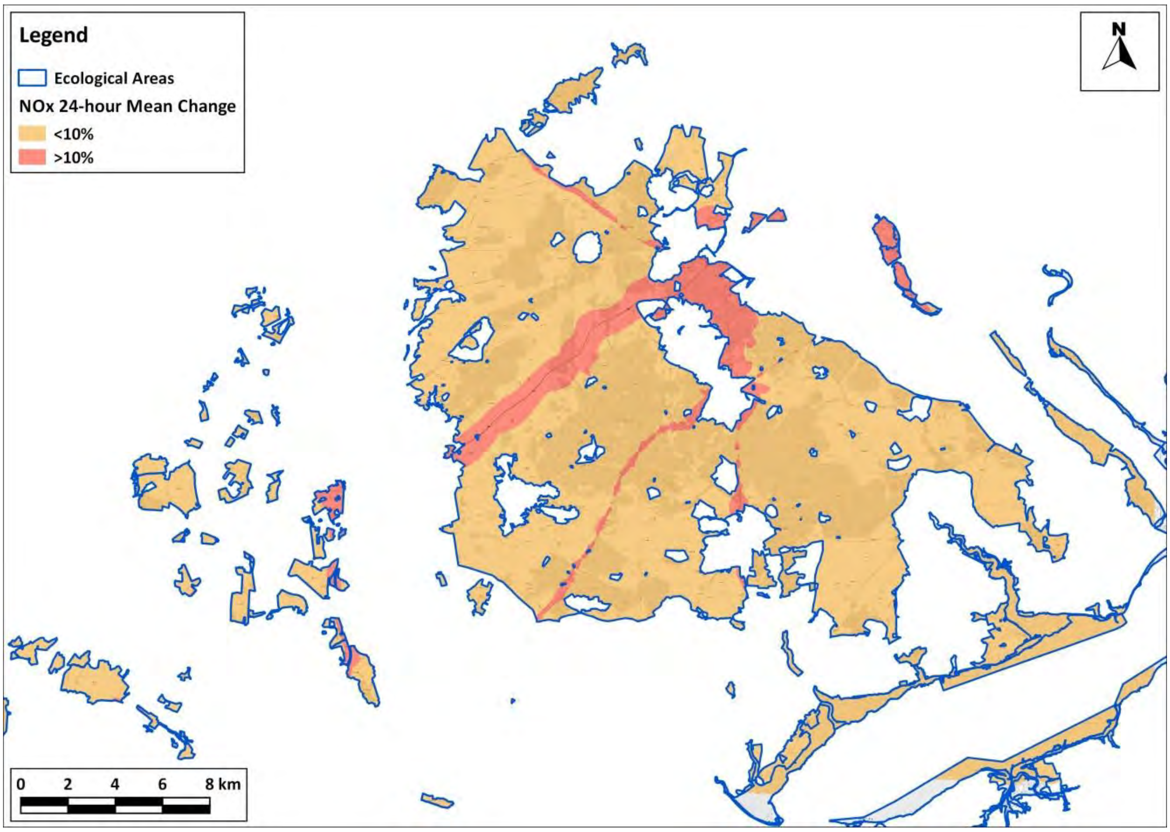

Figure A3.23: 2026 In-Combination 24-Hour NOx Percentage Change

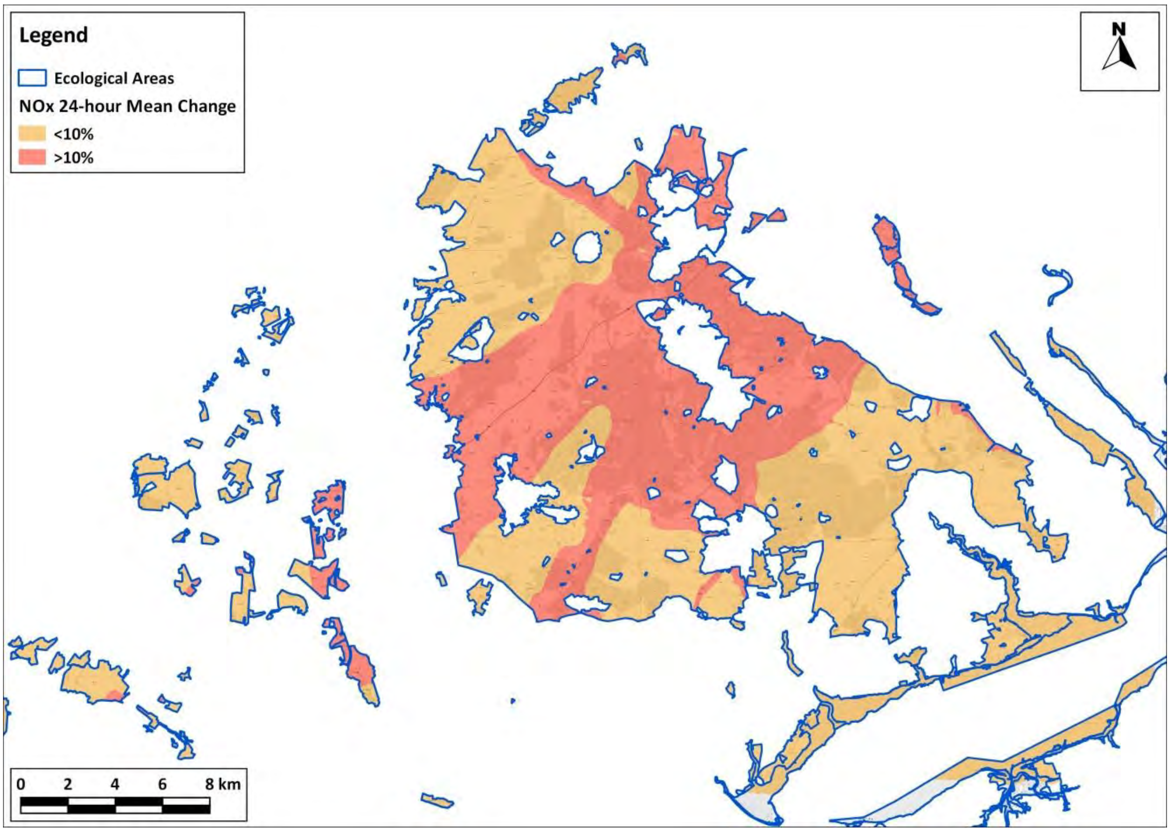

Figure A3.24: 2026 In-Combination 24-Hour NOx Percentage Change Sensitivity Test

Annual Mean Ammonia

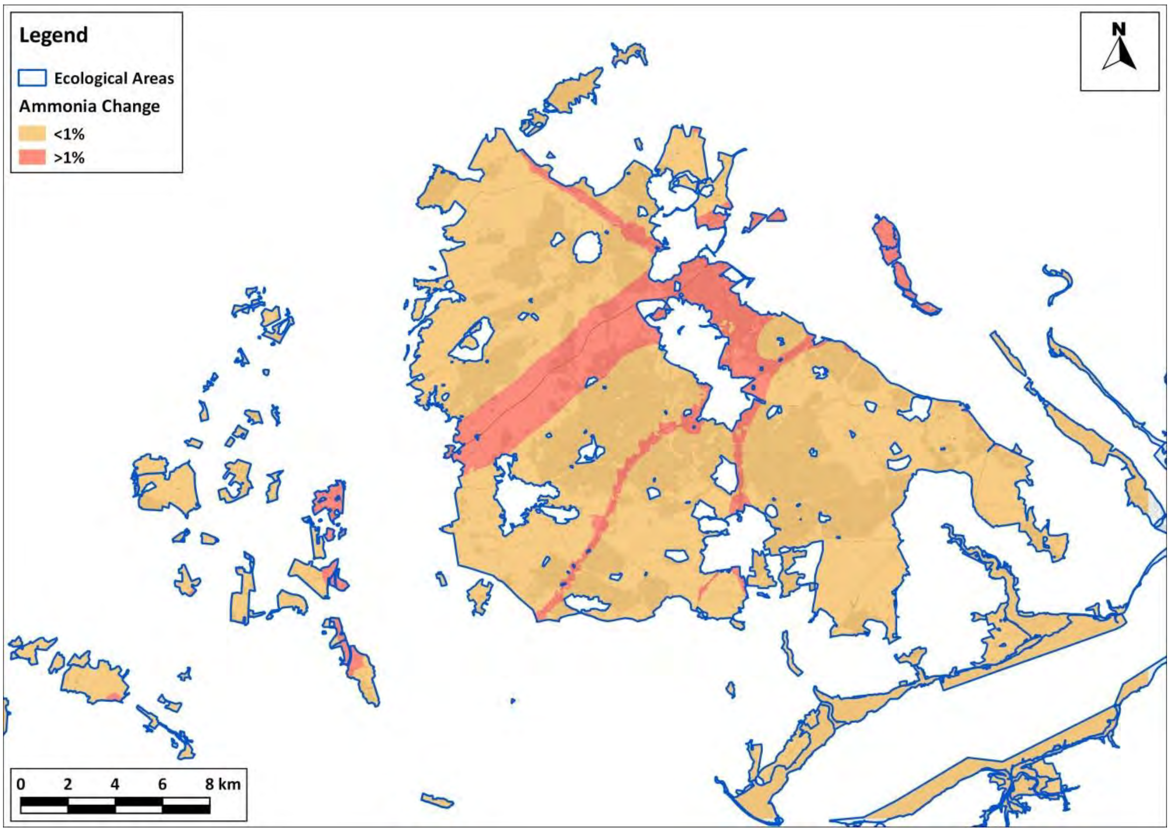

Figure A3.25: 2026 In-Combination Annual Mean Ammonia Percentage Change

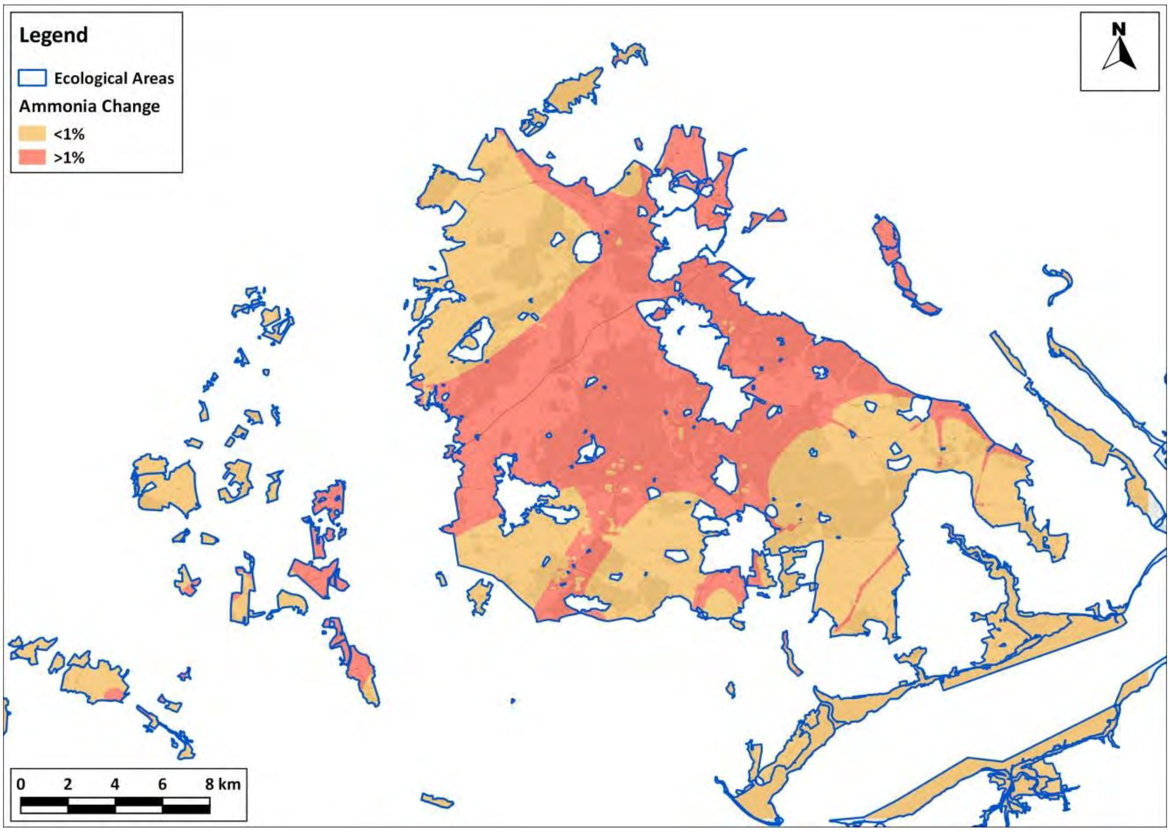

Figure A3.26: 2026 In-Combination Annual Mean Ammonia Percentage Change Sensitivity Test

Nutrient Nitrogen Deposition

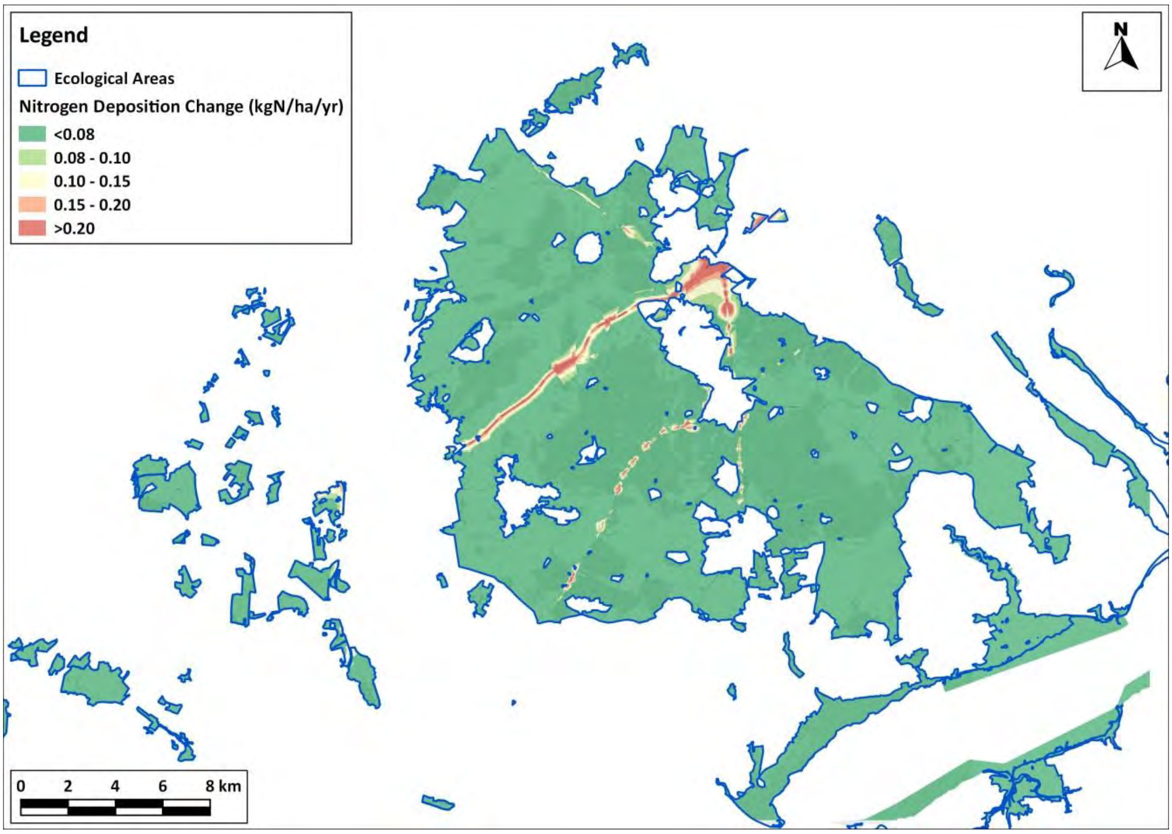

Figure A3.27: 2026 In-Combination Nutrient Nitrogen Deposition Absolute Change

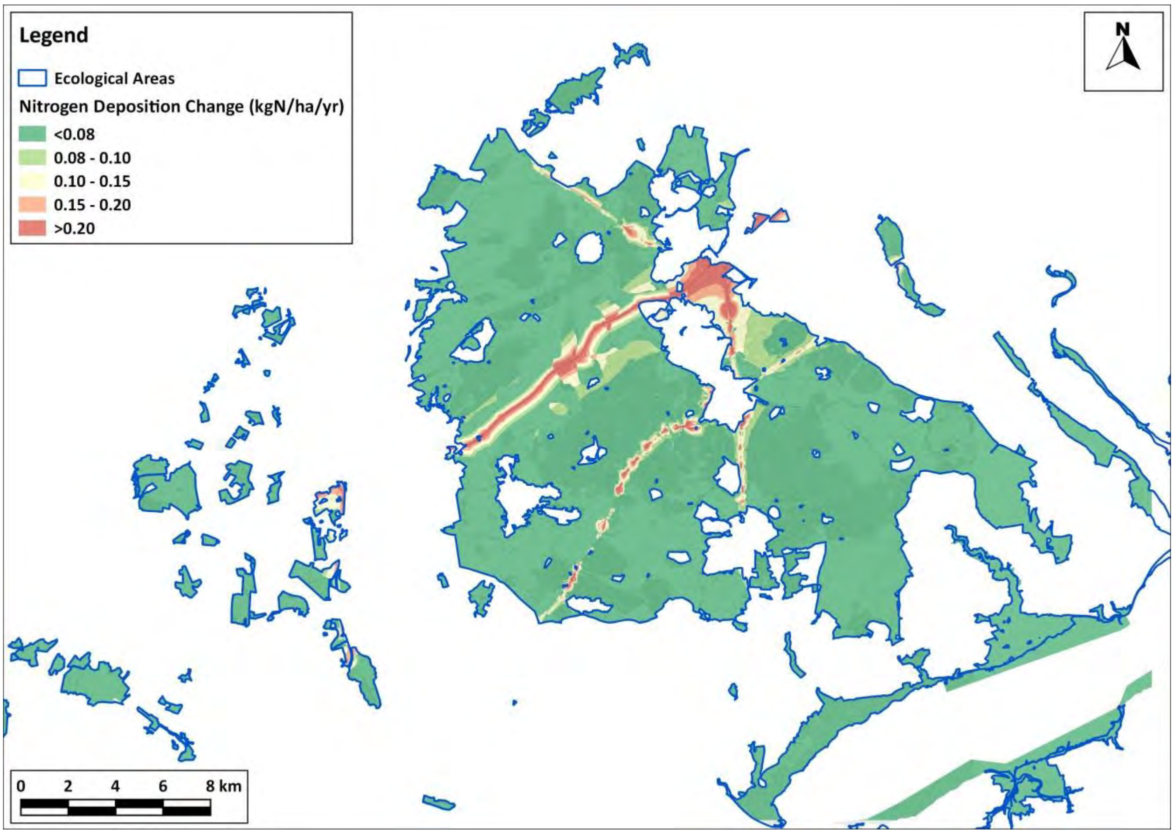

Figure A3.28: 2026 In-Combination Nutrient Nitrogen Deposition Absolute Change Sensitivity Test

2036 In-Combination

Annual Mean NOx

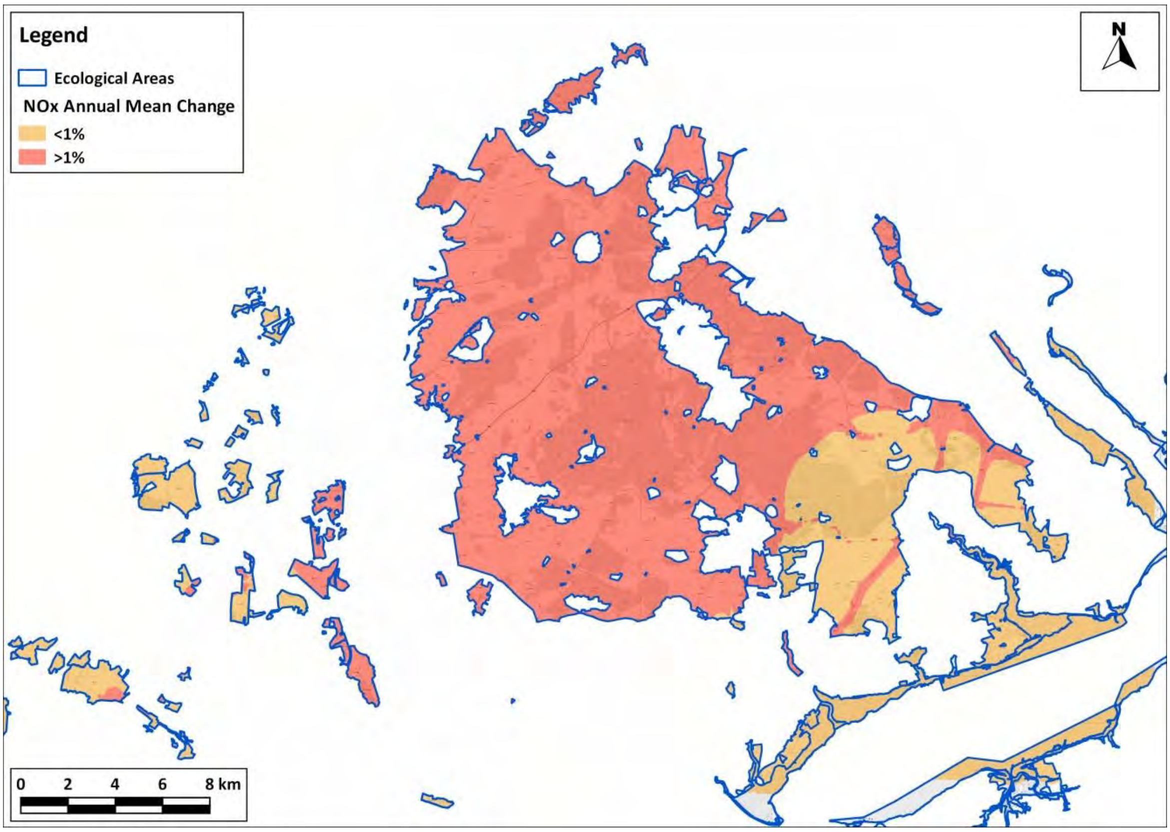

Figure A3.29: 2036 In-Combination Annual Mean NOx Percentage Change

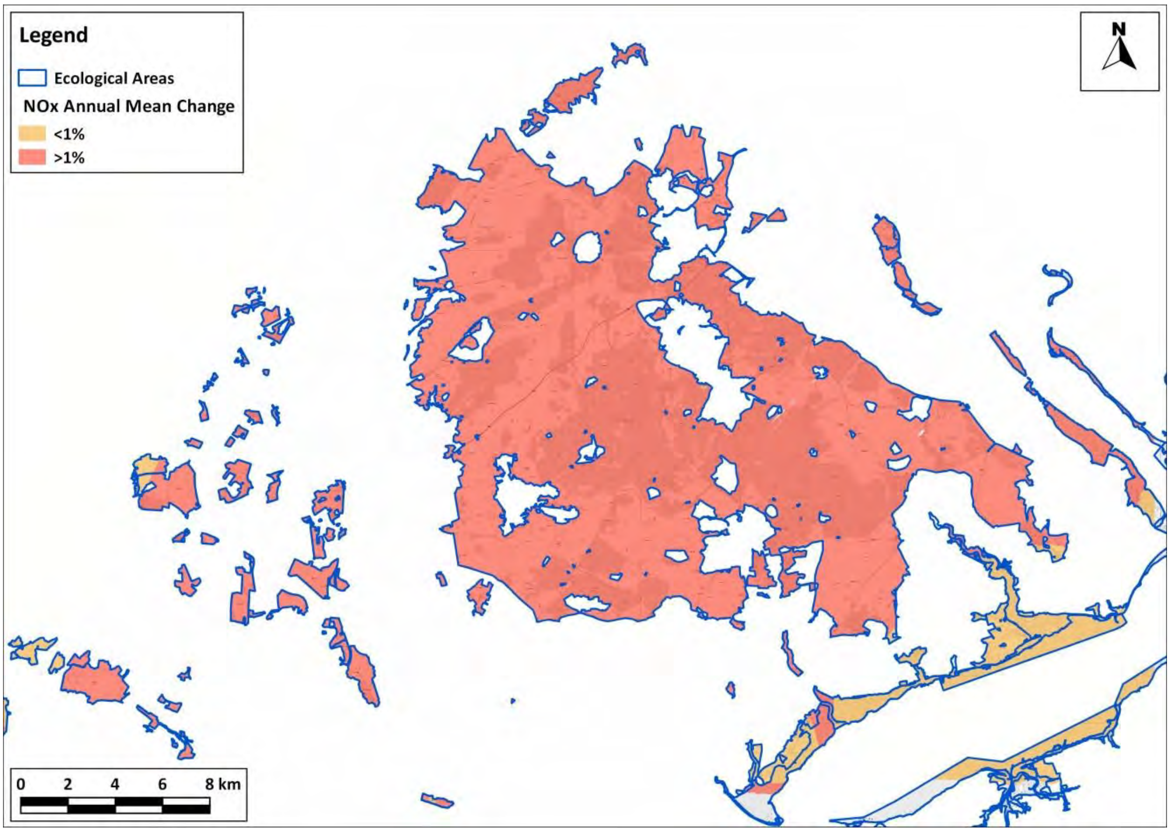

Figure A3.30: 2036 In-Combination Annual Mean NOx Percentage Change Sensitivity Test

24-Hour NOx

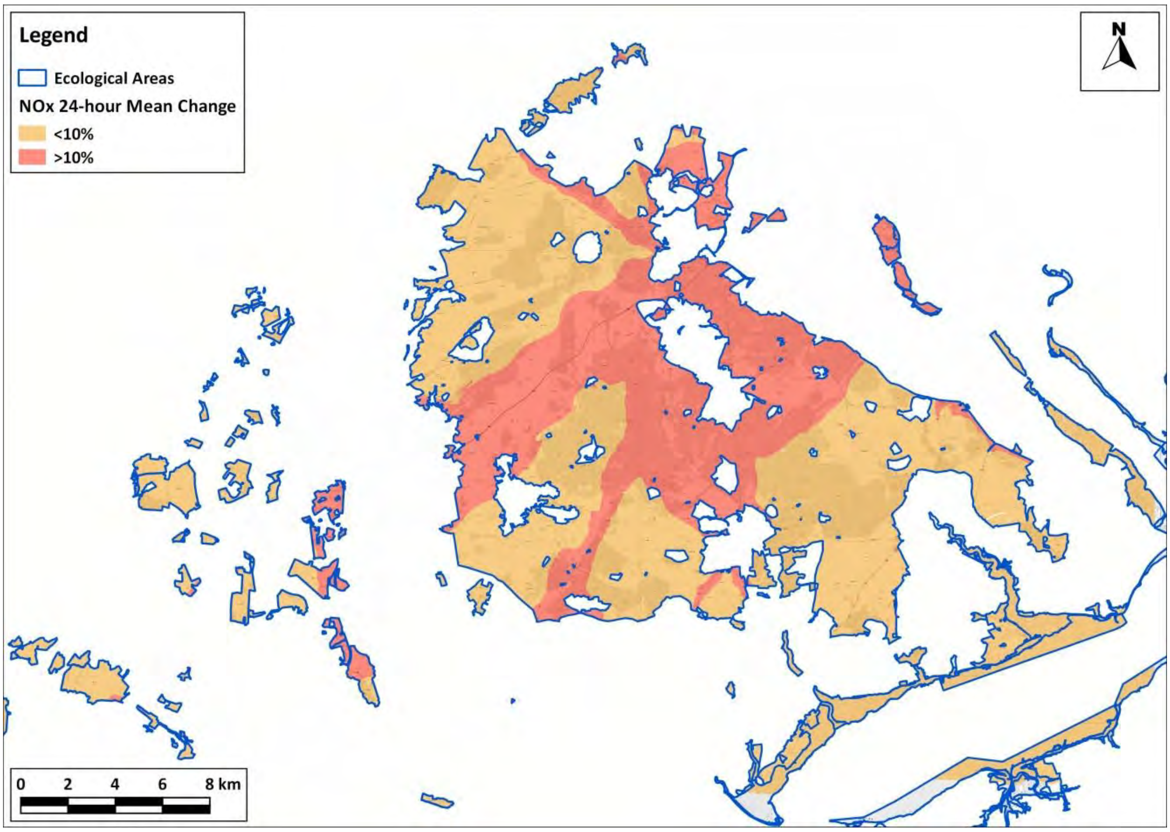

Figure A3.31: 2036 In-Combination 24-Hour NOx Percentage Change

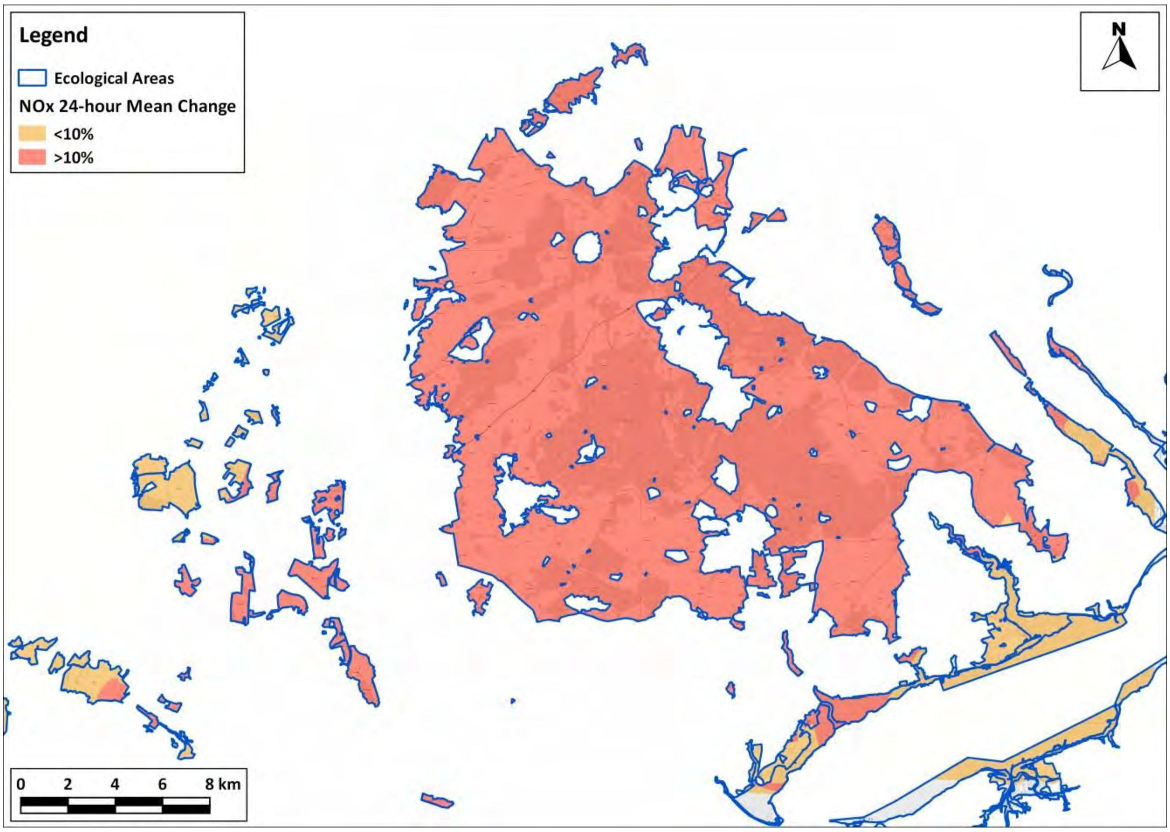

Figure A3.32: 2036 In-Combination 24-Hour NOx Percentage Change Sensitivity Test

Annual Mean Ammonia

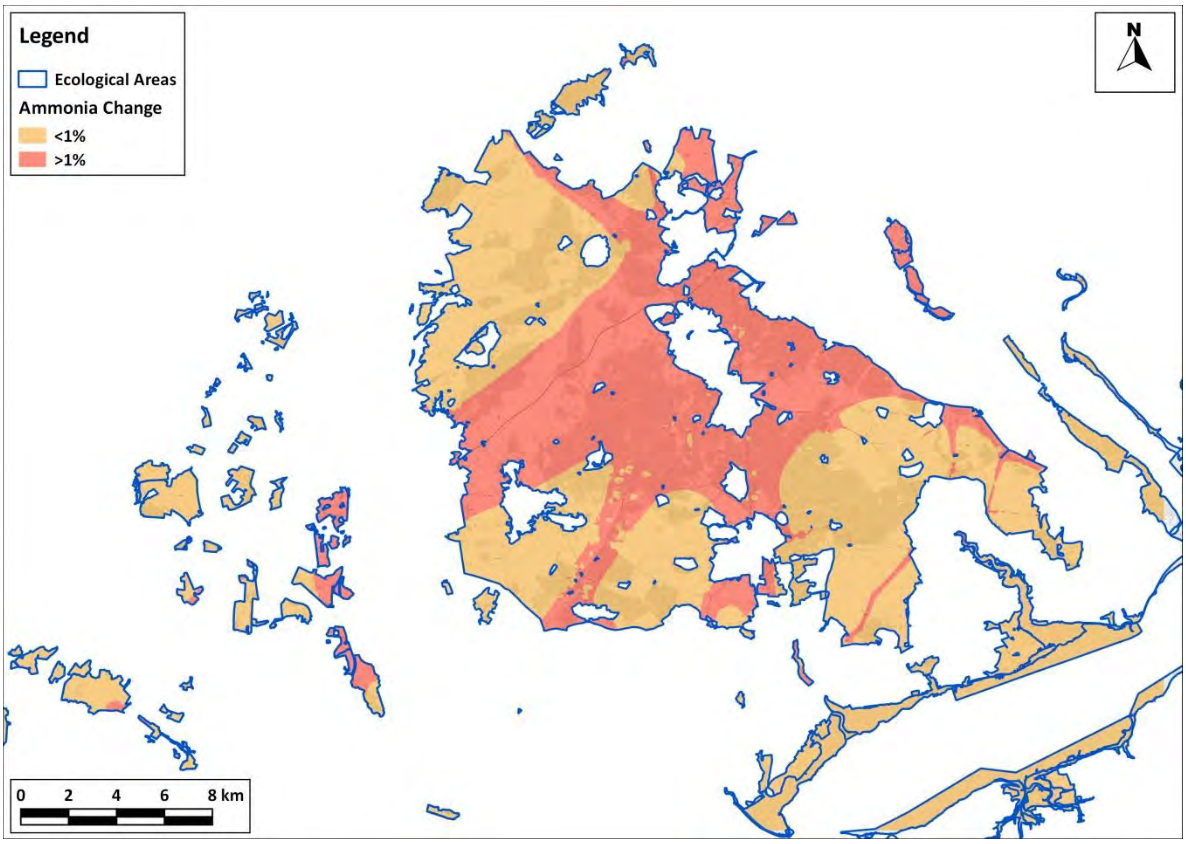

Figure A3.33: 2036 In-Combination Annual Mean Ammonia Percentage Change

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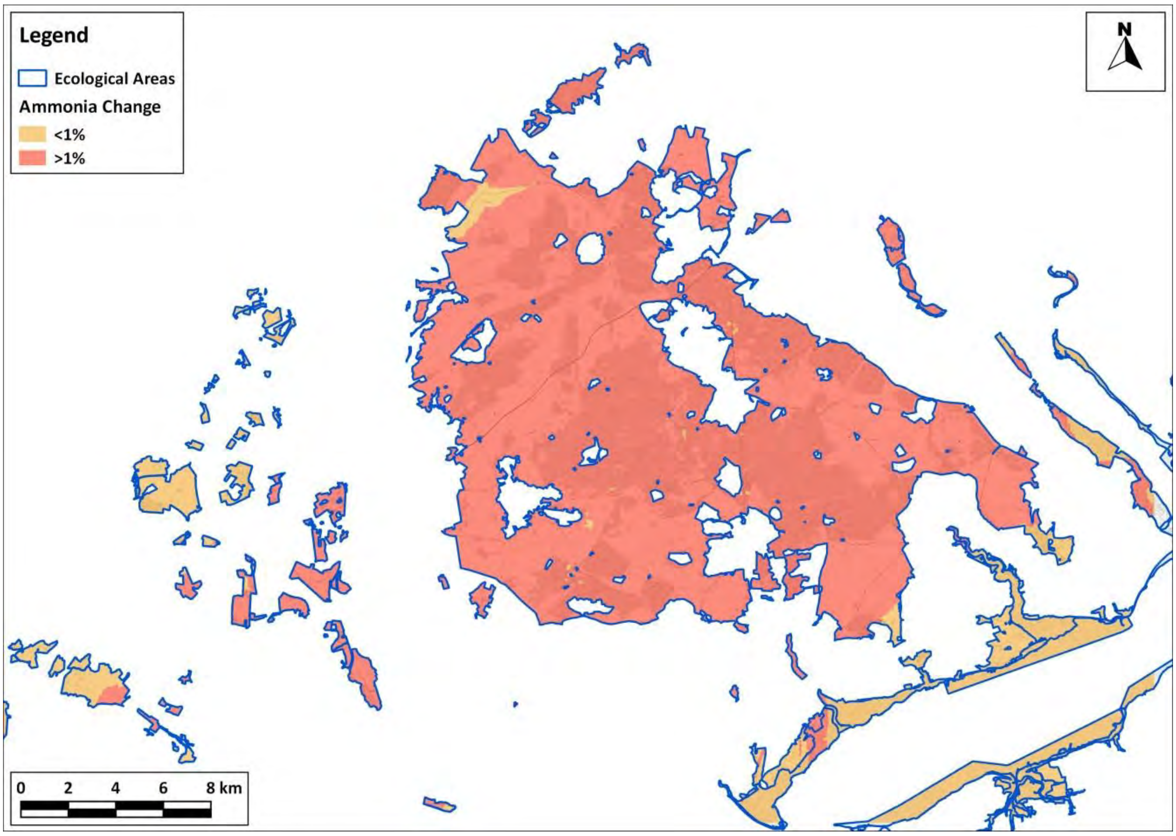

Figure A3.34: 2036 In-Combination Annual Mean Ammonia Percentage Change Sensitivity Test

Nutrient Nitrogen Deposition

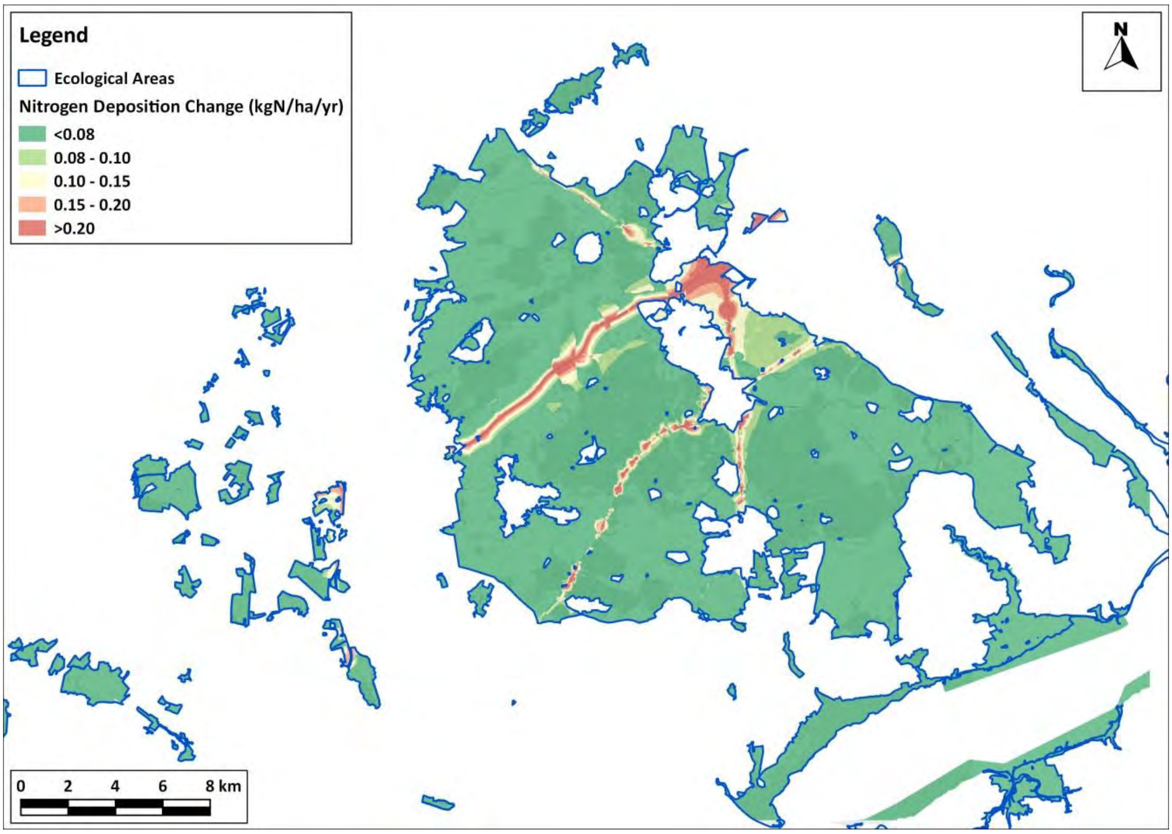

Figure A3.35: 2036 In-Combination Nutrient Nitrogen Deposition Absolute Change

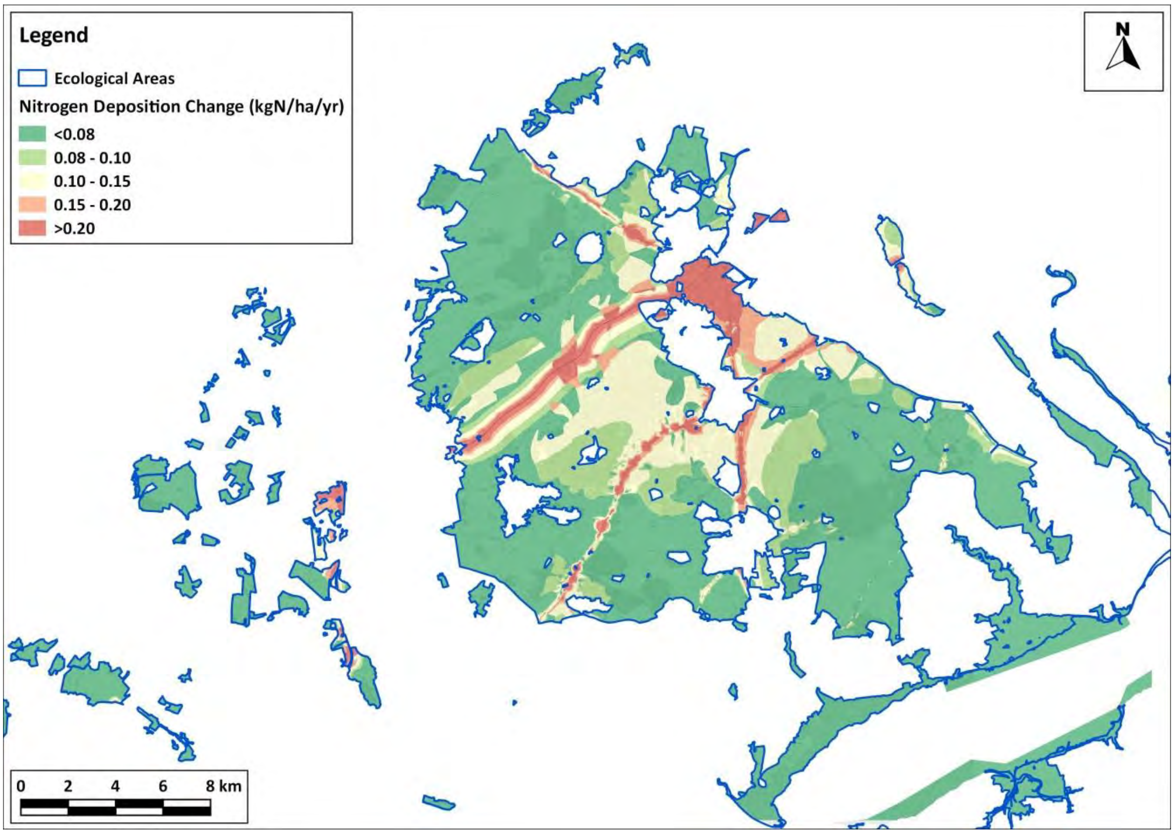

Figure A3.36: 2036 In-Combination Nutrient Nitrogen Deposition Absolute Change Sensitivity Test