Air Quality Habitat Regulations Assessment (HRA) for Short-Term Development in Fareham Borough

Report for Fareham Borough Council

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Fareham Borough Council

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Executive Summary

The Borough of Fareham is located in South Hampshire. There are approximately 116,000 people living within the Fareham Borough area of 74 km^2. There are currently short-term development applications in Fareham awaiting planning permission; short-term development in Fareham Borough envisages the provision of up to 3,327 new dwellings in the period from 1st April 2019 to 31st March 2023. This represents a significant increase in population in a relatively short amount of time, and associated increases in road traffic may have the potential for significant effects on air quality both within Fareham Borough and in surrounding areas.

Fareham Borough includes numerous nature conservation areas of national and international significance. These sites may be adversely affected by increases in air concentrations of pollutants, particularly oxides of nitrogen and ammonia, and the deposition of these pollutants within the habitats.

This report contains the results of an Air Quality Habitat Regulations Assessment (HRA) of road traffic emissions associated with the proposed short-term development within Fareham Borough. This study considers the potential impacts of short-term development within Fareham Borough in combination with anticipated development from neighbouring local authorities in the Partnership for South Hampshire (PfSH)[1] sub-region. The study area contains the designated sites with European (or equivalent international) designation, namely Ramsar sites, Special Areas of Conservation (SACs), and Special Protection Areas (SPAs) within an approximately 10 km buffer area around Fareham Borough.

For all European-designated sites contained in the study area, a sub-regional air dispersion model (RapidAIR) was used to model predicted air quality impacts at a resolution of 3m x 3m. Traffic growth within the study area was provided by Solent Transport's Sub-Regional Transport Model (SRTM), interpolated to the year 2023. Two traffic scenarios were modelled for the purposes of this study, in order to assess the potential air quality impacts of short-term development in the borough:

- Fareham 2023 Do Nothing (Fareham 2023 DN): This is a hypothetical scenario against which to test the impacts of short-term development in Fareham Borough, as it assumes the unlikely scenario that there will be no development within Fareham and the PfSH region up to 2023, other than at sites which already have planning permission.
- Fareham 2023 Do Minimum (Fareham 2023 DM): This model represents a scenario including all known current (as of 2019) completed development and infrastructure within Fareham, in addition to all anticipated development up to 2023. This model scenario includes development and growth within the PfSH region in order to account for in-combination effects. It includes transport schemes that are already committed as well as several supporting schemes that are vital to committed development sites even though the schemes themselves may not yet be committed.

Air quality impacts on designated sites were assessed based on predicted annual average airborne concentrations of oxides of nitrogen (NOx) and ammonia (NH_3), as well as annual deposition of nutrient nitrogen and acid. Predicted pollutant contributions associated with the proposed development in the Fareham 2023 DM scenario was compared to pollutant screening thresholds. Where the screening analysis indicated that Likely Significant Effects (LSEs) on a designated site could not be ruled out, further analysis was undertaken in the form of an HRA Stage 2 Appropriate Assessment.

This Air Quality HRA indicates that, after appropriate mitigation, there will not be an adverse effect on the integrity of these European sites as a result of short-term development in Fareham Borough:

[1] The Partnership for South Hampshire (PfSH) was previously known as the Partnership for Urban South Hampshire (PUSH).

- Chichester and Langstone Harbours Ramsar & SPA
- New Forest Ramsar & SPA
- New Forest SAC
- Portsmouth Harbour Ramsar & SPA
- River Itchen SAC
- Solent and Dorset Coast potential SPA
- Solent and Isle of Wight Lagoons SAC
- Solent and Southampton Water Ramsar & SPA
- Solent Maritime SAC

Based on the results of this study, we recommend the following:

- Development in Fareham can take place over the period up to 2023 as set out in this report, with no threat due to emissions to air to the ability of any European site to achieve their conservation objectives or maintain their integrity (either alone or in combination).

  The conclusion that short-term development in Fareham Borough will not result in adverse effects with regards to oxides of nitrogen (NOx) concentrations at Chichester and Langstone Harbours Ramsar & SPA, Portsmouth Harbour Ramsar & SPA, River Itchen SAC, Solent and Southampton Water Ramsar & SPA, and Solent Maritime SAC takes account of forecast trends in NOx, as set out in projections carried out by Defra. While there is currently no basis for reasonable scientific doubt in the forecast NOx levels, it is recommended that Fareham maintain a watching brief on the Defra forecasts of future trends in airborne NOx, and that a formal review take place at least once every three years. It would be appropriate for this formal review to take place as part of the programme for wider-ranging review of the Fareham Borough Local Plan HRA.

  Adverse effects from in-combination short-term development within the PfSH region, relating to increased nitrogen deposition to Perennial vegetation of stony banks (PVSB), a qualifying feature of Solent Maritime SAC, cannot be ruled out without mitigation. In order to address the adverse effect of nitrogen deposition identified at Solent Maritime SAC to PVSB, a joint Nitrogen Action Plan is being developed by Havant Borough Council with Portsmouth City Council under the Duty to Co-Operate.

  At the present time Fareham Borough Council is not able to quantify the individual contribution of development within Fareham to the in-combination effects on the Solent Maritime PVSB; this quantification will occur as part of the Fareham Borough Local Plan HRA process.

  Following receipt of the quantification results, Fareham Borough Council may need to work with Havant Borough Council and Portsmouth City Council (and any other relevant local authorities) to further develop and implement the Nitrogen Action Plan on a proportionate basis, to ensure that no adverse effects result from the proposed development in Fareham and neighbouring authorities.

  The existing HRA evidence base for designated sites in the New Forest District Council area shows there is already a system in place to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest Ramsar, SPA and SAC.

  At the present time, Fareham Borough Council is not able to quantify the individual contribution of development within Fareham to the in-combination effects on the New Forest Ramsar, SPA and SAC; this quantification will occur as part of the Fareham Borough Local Plan HRA process.

It is noted that the New Forest Ramsar, SPA and SAC are some distance outside Fareham Borough's boundaries.

Following receipt of the quantification results, Fareham Borough Council may need to work with New Forest District Council and the New Forest National Park Authority (and any other relevant local authorities), on a proportionate basis, to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest Ramsar, SPA and SAC.

Natural England has agreed that the approaches in this HRA are appropriate, providing the issues identified in respect of the Solent Maritime PVSB and the New Forest Ramsar, SPA and SAC are reassessed as part of the local plan HRA.[2]

[2] Email from Rachel Jones, Natural England, 06/12/2019.

Table of contents

Abbreviations

Abbreviation	Explanation
AADT	Annual Average Daily Traffic
APIS	Air Pollution Information System
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network
BEIS	UK Department for Business, Energy & Industrial Strategy
BL	Baseline (a future-year model scenario)
CAZ	Clean Air Zone
CL	Critical Limit/Level
DM	Do Minimum (a future-year model scenario)
EEA	European Environment Agency
EFT	Emissions Factor Toolkit
EMEP	European Monitoring and Evaluation Programme
FBC	Fareham Borough Council
GDM	Gateway Demand Model
GIS	Geographic Information System
HBC	Havant Borough Council
HBIC	Hampshire Biodiversity Information Centre
HGV	Heavy Goods Vehicle
HBLP	Havant Borough Local Plan
HRA	Habitat Regulations Assessment
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LEIM	Local Economic Impact Model
LES	Low Emission Strategy
LGV	Light Goods Vehicle
MDM	Main Demand Model
NAEI	National Atmospheric Emissions Inventory
NH_3	Ammonia
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (NO + NO_2)
NTEM	National Trip End Model
NTS	National Travel Survey
PHI	Priority Habitat Inventory, a GIS dataset from Natural England
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter
PM_{10}	Particulate matter 10 micrometres or less in diameter
PTM	Public Transport Model
PfSH	Partnership for South Hampshire; formerly known as PUSH (Partnership for Urban South Hampshire)
RMSE	Root Mean Square Error
RTM	Road Traffic Model

Abbreviation	Explanation
SAC	Special Area of Conservation
SPA	Special Protection Area
SRTM	Sub-Regional Transport Model
SSSI	Site of Special Scientific Interest

1 Introduction

The Borough of Fareham is located in South Hampshire, and is adjacent to Eastleigh, Winchester, Gosport and the City of Portsmouth. There are approximately 116,000 people living within the Fareham Borough area of 74 km^2. There are currently short-term development applications in Fareham awaiting planning permission, for which Natural England has indicated the air quality impacts should be assessed in line with their guidance.[3] Short-term development in Fareham Borough envisages the provision of up to 3,327 new dwellings in the period from 1st April 2019 to 31st March 2023. This represents a significant increase in population in a relatively short amount of time, and associated increases in road traffic may have the potential for significant effects on air quality both within Fareham Borough and in surrounding areas.

Being bordered by coasts and the Solent to the south, the River Hamble to the west, and adjacent to Portsmouth Harbour to the east, the area surrounding Fareham Borough includes numerous nature conservation areas of national and international significance. These sites may be adversely affected by increases in air concentrations of pollutants, particularly oxides of nitrogen and ammonia, and the deposition of these pollutants within the habitats.

This report contains the results of an Air Quality Habitat Regulations Assessment (HRA) of road traffic emissions associated with the proposed short-term development within Fareham Borough. This study considers the potential impacts of short-term development within Fareham Borough in combination with anticipated development from neighbouring local authorities in the PfSH sub-region.[4] The study area contains the designated sites with European (or equivalent international) designation, namely Ramsar sites, Special Areas of Conservation (SACs), and Special Protection Areas (SPAs) within an approximately 10 km buffer area around Fareham Borough.

For all European-designated sites contained in the study area, a sub-regional air dispersion model (RapidAIR) was used to model predicted air quality impacts at locations within the site at a resolution of 3m x 3m. Traffic growth within the study area was provided by Solent Transport's Sub-Regional Transport Model (SRTM)[5], interpolated to the year 2023. Two traffic scenarios were modelled for the purposes of this study, in order to assess the potential air quality impacts of short-term development in the borough:

- Fareham 2023 Do Nothing (Fareham DN): This model represents a scenario including all known current (as of 2019) completed development and infrastructure within Fareham and the PfSH region, in addition to all committed development and infrastructure up to 2023. Anticipated short-term development within Fareham Borough and within the larger PfSH region are not included in this scenario. This is a hypothetical scenario against which to test the impacts of the anticipated short-term development, as it assumes the unlikely scenario that there will be no development within Fareham and the PfSH region up to 2023, other than at sites which already have planning permission.
- Fareham 2023 Do Minimum (Fareham DM): This model represents a scenario which includes the anticipated short-term housing and employment development within Fareham and the PfSH region, but assumes there will be no further improvements to the transport network, aside from those which are already committed and therefore already included in the Fareham DN scenario.

[3] Natural England, "Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations", Version: June 2018.

[4] The PUSH sub-region includes City of Portsmouth, City of Southampton, Eastleigh Borough, East Hampshire District (part), Fareham Borough, Gosport Borough, Havant Borough, Test Valley Borough (part), and Winchester City (part)

[5] Systra, "Technical Report: Push Development & Transport Interventions, 2036 PUSH Do Something Versus 2014 Base", Reference number 102827, 03/06/2016.

Air quality impacts on designated sites were assessed based on predicted annual average airborne concentrations of oxides of nitrogen (NOx) and ammonia (NH_3), as well as annual deposition of nutrient nitrogen and acid. This study considers the total predicted air quality impacts from in-combination development (housing development within Fareham and neighbouring local authorities) but does not quantify the contribution from development occurring within Fareham alone. Predicted pollutant contributions associated with the proposed development in the Fareham 2023 DM scenario were compared to pollutant screening thresholds. Where the screening analysis indicated that Likely Significant Effects (LSEs) on a designated site could not be ruled out, further analysis was undertaken in the form of an HRA Stage 2 Appropriate Assessment.

Fareham is in the process of updating its local plan up to the year 2036. As part of that process, new transport modelling studies have been commissioned to consider the effects of local development within Fareham, in isolation. Fareham Borough Council has commissioned an air quality HRA based on that transport modelling, which will be able to quantify the contribution of the Fareham local plan, in isolation, to air quality impacts on designated sites. The local plan HRA will also quantify and consider air quality impacts of Fareham's local plan in combination with local development in neighbouring authorities, up to the year 2036. It is anticipated that the local plan HRA will be completed within the next few months, subject to completion of the underpinning transport modelling.

2 Method Statement

2.1 Study Overview

This study has been carried out using air dispersion modelling to predict the air quality impacts of increased vehicle emissions arising from short-term housing and employment development in Fareham Borough up to the end of March 2023. To account for in-combination impacts from development within multiple local authorities, the air dispersion modelling is underpinned by a transport model which explicitly includes in-combination impacts from housing development throughout the South Hampshire region. The model includes development in East Hampshire (part), Eastleigh, Fareham, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

The in-combination transport model was originally designed to account for combined development in the South Hampshire region up to the year 2034. For the purposes of this study, the transport model has been projected back to the year 2023, using a scaling factor based on Fareham's anticipated level of development in 2023 (an additional 3,327 dwellings from 2019) versus the anticipated development in 2034. This approach has assumed that neighbouring local authorities follow a similar development trajectory in terms of their development in 2023 compared to 2034.

Aside from housing development, no other plans or projects have been identified for consideration of in-combination effects.

This chapter begins by describing the transport modelling upon which the air quality modelling was based, using information from the traffic model developers (MVA Consultancy). It then goes on to describe the transport model projection and air quality modelling methodology utilised for the two Fareham model scenarios (referred to as "Fareham 2023 DN" and "Fareham 2023 DM"), as well as the methodology for the assessment of impacts on designated sites.

2.2 Sub-Regional Transport Model (SRTM)

2.2.1 Transport model development

MVA Consultancy was commissioned to develop a Sub-Regional Transport Model (SRTM) that covered the South Hampshire sub-region, including the areas of Southampton and Portsmouth. The SRTM was developed to support a wide-ranging set of interventions across the sub-region, and was specifically required to be capable of the following:[6]

- Forecasting changes in travel demand, road traffic, public transport patronage and active mode (walking and cycling) use over time as a result of changing economic conditions, land-use policies and development, and transport improvements and interventions;
- Testing the impacts of land-use and transport policies; and
- Testing the impacts of individual transport interventions in the detail necessary for preparing submissions for inclusions in funding programmes.

The SRTM includes four main model regions (core, marginal, buffer and external; Figure 2-1), which have been modelled to varying levels of detail. The core region includes Test Valley (in part), New Forest (in part), Southampton, Eastleigh, Winchester (in part), Fareham, Gosport, Portsmouth, Havant, East Hampshire (in part) and Isle of Wight. Each of the four main model regions is further broken down into model zones. The zones within the core and marginal model regions are mainly based on groups

[6] MVA Consultancy, "Transport for South Hampshire Evidence Base Model Development Report: Report 2", MVA Project Number C39344, August 2011.

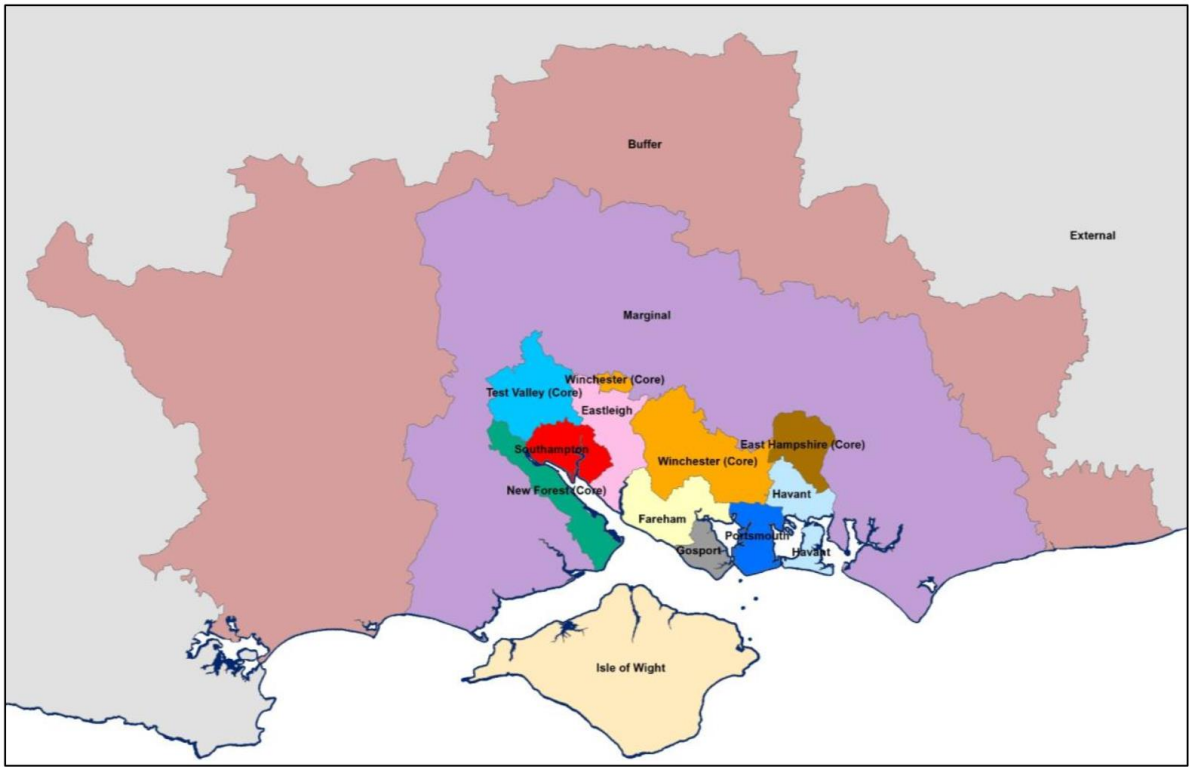
of Census Output Areas (COAs) and Census Wards (CWs), respectively. Zones are based on Districts immediately outside the marginal model area, and on Counties in the model areas farther away. Key transport model parameters such as land use are specified by zone, and consequently the core model region has been modelled at the highest resolution and with the greatest level of detail; model resolution and detail decrease in zones farther away from the model core.

The SRTM is a suite of linked models comprised of the following components:

- Main Demand Model (MDM) which predicts when (frequency and time of day), where (destination choice) and how (choice of mode) journeys are made. Mode choices include car, public transportation, park & ride (a combination of car and public transportation), and active modes (walking and cycling).
- Gateway Demand Model (GDM) which predicts demand for travel from ports and airports.
- Road Traffic Model (RTM) which determines the routes taken by vehicles through the road network and journey times, accounting for congestion.
- Public Transport Model (PTM) which determines routes and services chosen by public transport passengers.
- Local Economic Impact Model (LEIM) which uses inputs including transport costs to forecast quantities and locations of households, populations and jobs.

The model components interact as demonstrated in Figure 2-2.

Figure 2-1 SRTM geographical coverage[5]

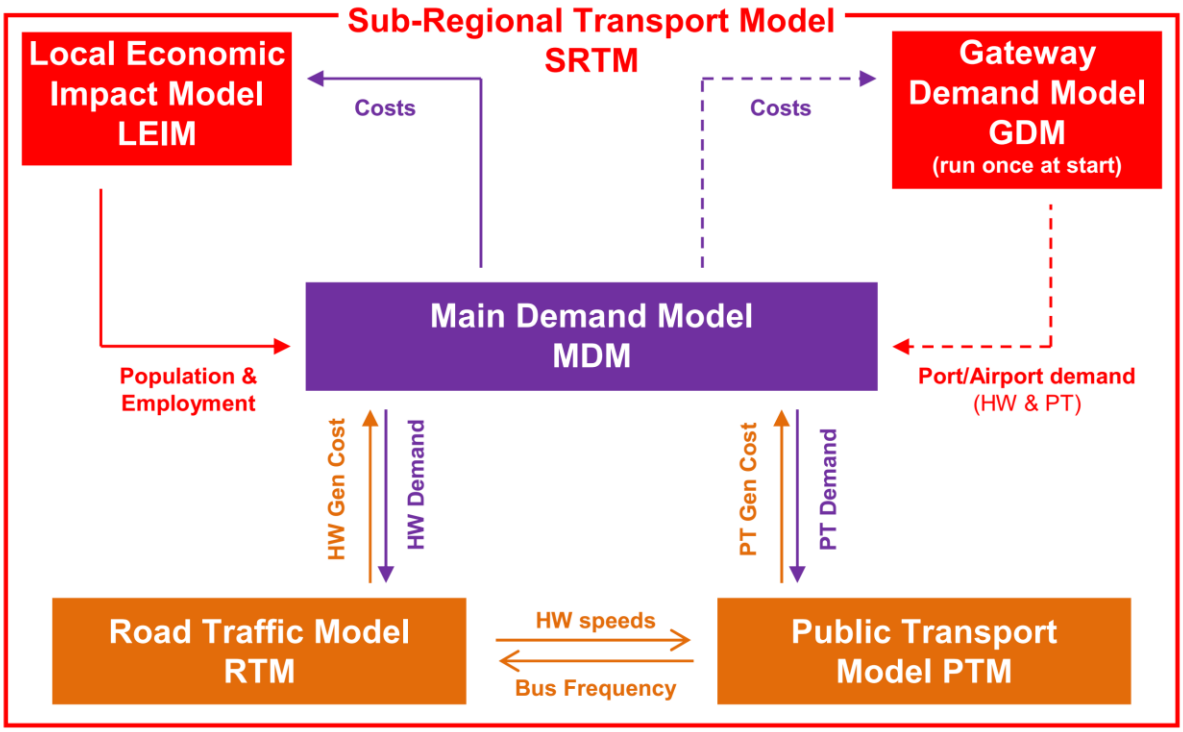


The SRTM is an evidence-based Land-Use and Transport Interaction model. The SRTM was originally developed, calibrated and validated against 2010 data and conditions, and included five forecast years: 2014, 2019, 2026, 2031, and 2036. Data sources included:

- Roadside interview survey data;

- Rail Travel Survey;
- Public transport origin destination data;
- Ticket data for buses;
- On board counts;
- Manual and automatic traffic counts;
- Journey time data;
- Census Journey to Work Data;
- National Travel Survey (NTS) Data;
- National Trip End Model (NTEM) Data; and
- Population and Employment Data.

Figure 2-2 Interaction of models included in the SRTM[6]



2.2.2 Factors which influence trip generation and road link speeds

Trip generation is determined at a zonal level and is a function of demographics and socio-economic characteristics. It is sensitive to changes in land use rather than changes in travel cost.[6] The SRTM accounts for ten land use categories: residential, retail, office, industrial, warehousing, primary & secondary education, adult education, hotel & other accommodation, healthcare and leisure.

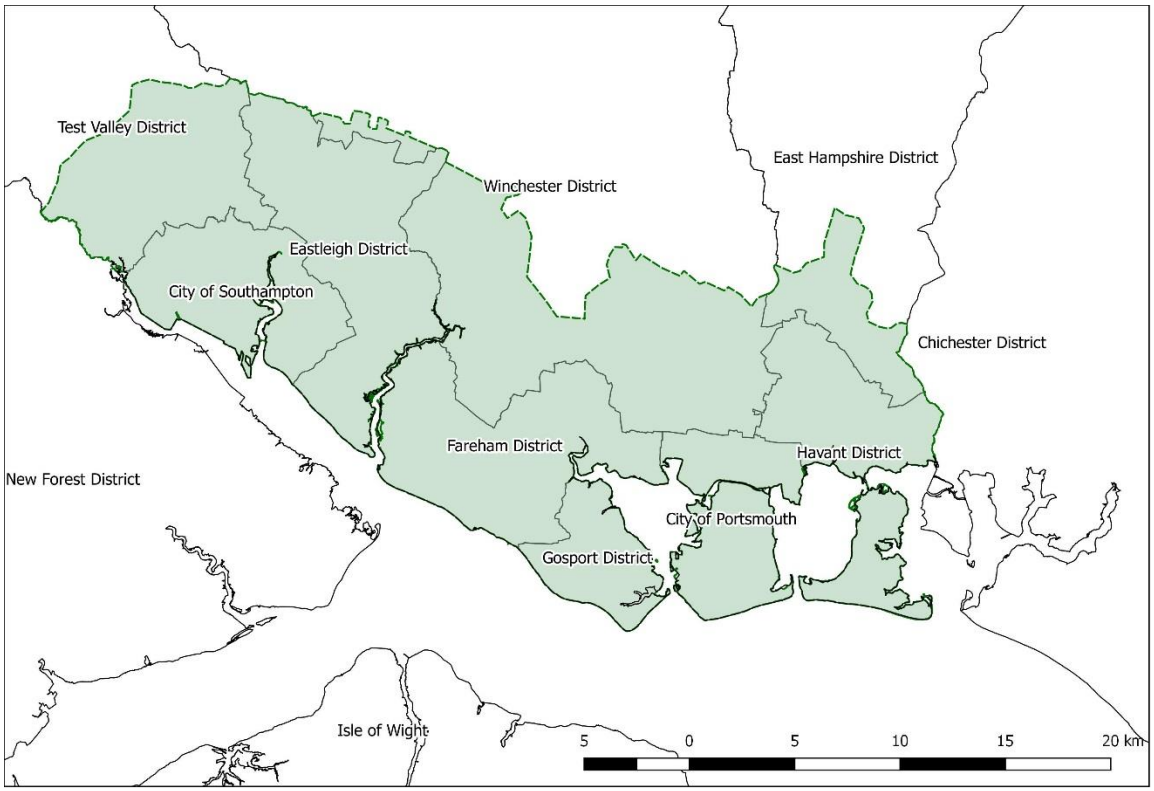
Cruise speeds between junctions in the core SRTM area were derived from GPS-based TrafficMaster data. Each modelled road link was allocated a link category, based on factors such as road type, number of lanes, speed limit, presence of buses, etc. For each link category, average speeds were calculated from all TrafficMaster data for that category. The averages were calculated such that links with high standard deviations for speeds received a lower weighting, and consequently had less influence on the average, than links with low standard deviations for average speed. In addition, major roads (dual carriageways and motorways) were coded with speed flow relationships which vary speeds on these links.

The average speeds on modelled road links, as determined by the SRTM, depend on the cruise speeds, the specified link capacity, and the occurrence of saturation conditions. Saturated conditions constrain traffic volumes at downstream locations, and queues with reduced journey speeds result at junctions which are over capacity.

2.2.3 Original PfSH scenarios

As previously discussed, this study utilises the transport model originally adapted from the SRTM by Systra for the recently published PfSH AQIA[7]. The PfSH study area (Figure 2-3) includes the City of Portsmouth, City of Southampton, Eastleigh Borough, East Hampshire District (part), Fareham Borough, Gosport Borough, Havant Borough, Test Valley Borough (part), and Winchester City (part). The "Do Minimum" and "Do Something" traffic scenarios used in the assessment accounted for future proposed development and housing in the PfSH sub-region, which is a larger area encompassing the study area as well as the Isle of Wight and part of New Forest District. Air quality impacts within the study area therefore account for in-combination effects from increased traffic across the larger PfSH sub-region.

Figure 2-3 PfSH study area



Traffic growth within the study area was provided by Solent Transport's Sub-Regional Transport Model (SRTM). In total, four traffic scenarios were modelled as part of the original PfSH study:

- PfSH 2014 Reference Case: This model was designed to replicate 2014 traffic conditions within the PfSH sub-region. It was used to verify the performance of the air dispersion model and investigate baseline air quality conditions within the study area.
- PfSH 2034 Baseline Scenario: This model was designed to represent a future scenario without the proposed PfSH development, and it has all land use growth inputs removed from the PfSH sub-region from 2014 onwards. The scale and location of development are assumed to be

[7] Ricardo Energy & Environment, "Partnership for Urban South Hampshire: Air Quality Impact Assessment", reference ED 10415100, Issue no. 3, 05/09/2018.

unchanged from 2014 conditions within the PfSH sub-region. For the remaining model areas outside of the PfSH sub-region, it is assumed that development and growth would continue as expected for 2034, and in accordance with TEMPRO v7.2 growth projections.

- PfSH 2034 Do Minimum Scenario: This model scenario includes development and growth within the PfSH region, equating to approximately 100,000 additional dwellings compared to the 2034 Baseline scenario. It includes transport schemes that are already committed as well as several supporting schemes that are vital to committed development sites even though the schemes themselves may not yet be committed.
- PfSH 2034 Do Something Scenario: This model scenario includes development and growth within the PfSH region, equating to approximately 100,000 additional dwellings compared to the 2034 Baseline scenario. This model scenario includes additional transport interventions, specified by the Solent Transport and PfSH authorities, which are aimed at helping to mitigate the impact of the proposed developments on the transport network.

2.2.4 Transport model update for Fareham Borough Council

For the purposes of this study, the PfSH transport model has been interpolated to the year 2023 using two scaling factors and the original PfSH scenarios, specifically the PfSH 2014 Reference Case, PfSH 2034 Baseline Scenario and PfSH 2034 Do Minimum Scenario outlined in Section 2.2.3.

The two scenarios used in this study are:

- Fareham 2023 Do Nothing (Fareham DN): This model represents a scenario including all known current (as of 2019) completed development and infrastructure within Fareham and the PfSH region, in addition to all committed development and infrastructure up to 2023. Anticipated short-term development within Fareham Borough and within the larger PfSH region are not included in this scenario. This is a hypothetical scenario against which to test the impacts of the anticipated short-term development, as it assumes the unlikely scenario that there will be no development within Fareham and the PfSH region up to 2023, other than at sites which already have planning permission.

  AADT values for this scenario were calculated as:

  $Fareham\_DN_{AADT} = PfSH\_2014_{AADT} + (PfSH\_2034\_Baseline_{AADT} – PfSH\_2014_{AADT})(0.69)(1.039)$

  Link speeds were calculated as an average of the speeds in the PfSH 2014 and PfSH 2034 Baseline scenarios.

- Fareham 2023 Do Minimum (Fareham DM): This model represents a scenario which includes the anticipated short-term housing and employment development within Fareham and the PfSH region, but assumes there will be no further improvements to the transport network, aside from those which are already committed and therefore already included in the Fareham DN scenario.

  AADT values for this scenario were calculated as:

  $Fareham\_DM_{AADT} = PfSH\_2014_{AADT} + (PfSH\_2034\_DM_{AADT} – PfSH\_2014_{AADT})(0.69)(1.039)$

  Link speeds were calculated as an average of the speeds in the PfSH 2014 and PfSH 2034 DM scenarios.

In the above equations, the first scaling factor (0.69) is based on Fareham's anticipated level of development in 2023 (53,519 dwellings) versus the level of development in 2014 (46,746 dwellings) and the anticipated development in the original PfSH 2034 development scenarios (56,564). In other words, 9818 dwellings are expected to be built between 2014 and 2034, and this study assumes that 6773 (69% of these) are expected to be built by 2023. This approach has assumed that neighbouring local authorities follow a similar development trajectory in terms of their development in 2023 compared

to 2034. The second scaling factor (1.039) accounts for current housing projections across the PfSH sub-region being higher than the housing projections used in the original PfSH study.

As discussed in Section 2.2.3, some links within the New Forest District were not included in the original PfSH transport model. Traffic flows for the main links running through the New Forest District were therefore calculated using DfT traffic count data[8] using methodology detailed in Section 2.3.4.

2.3 Air dispersion modelling methodology

2.3.1 Air quality modelling system

The RapidAIR Urban Air Quality Modelling Platform was used to predict air pollutant concentrations for this study. This is Ricardo Energy & Environment's proprietary modelling system developed for urban air pollution assessment, and the model that was used previously in Southampton for the Low Emission Strategy (LES) and Clean Air Zone (CAZ) studies, as well as for an assessment of the Royal Borough of Windsor and Maidenhead local plan completed in March 2018 and for the Partnership for Urban South Hampshire (PfSH) air quality impact assessment (AQIA) completed in September 2018.

RapidAIR has been developed to provide graphic and numerical outputs which are comparable with other models used widely in the United Kingdom. The model approach is based on loose-coupling of three elements:

- Road traffic emissions model conducted using fleet specific COPERT 5 (via the Defra EfT) algorithms to prepare grams/kilometre/second (g km^{-1} s^{-1}) emission rates of air pollutants originating from traffic sources.
- Convolution of an emissions grid with dispersion kernels derived from the USEPA AERMOD[9] model, at resolutions ranging from 1 m to 20 m. AERMOD provides the algorithms which govern the dispersion of the emissions and is an accepted international model for road traffic studies.
- The kernel based RapidAIR model running in GIS software to prepare dispersion fields of concentration for further analysis with a set of decision support tools coded by us in Python/arcpy.

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[10] and upper air data is downloaded from the NOAA Radiosonde database.[11]

The model produces high resolution concentration fields at the city scale (down to a 1 m scale) so is ideal for spatially detailed compliance modelling. The combination of an internationally recognised model code and careful parameterisation matching international best practice makes RapidAIR ideal for this study. A validation study has been conducted in London using the same datasets as the 2011 Defra air quality model inter-comparison study.[12] Using the LAEI (London Atmospheric Emissions Inventory) 2008 data and the measurements for the same time period the model performance is consistent (and across some metrics performs better) than other modelling solutions currently in use in

[8] https://roadtraffic.dft.gov.uk/#6/55.254/-6.053/basemap-regions-countpoints

[9] https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[10] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

[11] https://www.esrl.noaa.gov/roabs/

[12] https://uk-air.defra.gov.uk/research/air-quality-modelling?view=intercomparison

the UK.[13] This validation study has been published in *Environmental Modelling and Software*, in partnership with the University of Strathclyde.[14]

2.3.2 Model domain

The study area includes all areas of European-designated sites located within a 10 km buffer area around Fareham Borough: River Itchen (SAC), Solent & Isle of Wight Lagoons (SAC), Solent Maritime (SAC), Chichester & Langstone Harbours (SPA & Ramsar), Portsmouth Harbour (SPA & Ramsar), Solent & Southampton Water (SPA & Ramsar) and Solent & Dorset Coast (potential SPA). Areas of some of these sites are located partially on the Isle of Wight and partially on the mainland; in this case, those areas located on the Isle of Wight were excluded from the study, as there are no direct ferry links between Fareham and the Isle of Wight, and it is considered unlikely that short-term development within Fareham would have a significant contribution to an increase in vehicle numbers on the Isle of Wight. Additionally, other nearby European-designated sites were considered in terms of whether an 'exceptional impact pathway' may exist, such that a significant effect (either alone or in-combination) originating from within the Fareham development areas may impact upon a designated site located beyond the 10 km buffer. It was determined that there may be an exceptional impact pathway between Fareham Borough and the New Forest designated sites (SPA, SAC & Ramsar). The M27 is a significant road connecting the two, and as it is possible to drive from western areas of Fareham to the edges of the New Forest designated sites within about 30-45 minutes (depending on traffic), it would seem plausible that people could live in Fareham and commute to New Forest District, and/or vice-versa, to a degree that there could be a significant impact due to the Fareham development plan, either alone or in-combination. The New Forest designated sites (SPA, SAC & Ramsar) are also included in the study area.

Dispersion modelling was carried out to forecast levels of air pollutants at a 3 m x 3 m grid resolution across the entire Fareham Borough study area. A grid height of 1.5 m was modelled to represent human exposure at ground level. Dispersion modelling was carried out for two future 2023 scenarios (Do Nothing Scenario and Do Minimum Scenario).

Data were then extracted from the 3 m x 3 m grid results to provide a detailed evaluation of air quality impacts at locations within the relevant designated sites.

2.3.3 Traffic activity data

Annual average daily traffic (AADT) vehicle numbers and average vehicle speeds were extracted from the original PfSH SRTM datasets provided by Systra and used to calculate parameters for the two scenarios (Fareham 2023 DN and Fareham 2023 DM) used in this study. Further detailed information about the SRTM and the four transport model scenarios can be found in Section 2.2.

The SRTM includes four main model regions: core, marginal, buffer and external, as outlined in Section 2.2.1. The core model region has been modelled at the highest resolution and with the greatest amount of detail; model resolution and detail decrease in zones further away from the model core.

2.3.4 Supplementary traffic data

The core region contains the New Forest in part, however, certain important road links crossing the entirety of the site (such as the M27/A31 and the A36) were only included in the marginal and buffer regions. The links travelling through the New Forest are important because they are likely to include journeys to and from Fareham. Thus, following the extension of the modelling domain to include the

[13] The 2008 LAEI dataset was used in this context as a benchmarking study, to compare the performance of RapidAIR to other modelling systems. The 2008 LAEI dataset was not used as an input in the current modelling study.

[14] Masey, Nicola, Scott Hamilton, and Iain J. Beverland. "Development and evaluation of the RapidAIR® dispersion model, including the use of geospatial surrogates to represent street canyon effects." *Environmental Modelling & Software* (2018). DOI: https://doi.org/10.1016/j.envsoft.2018.05.014

New Forest, the SRTM data was supplemented with Department for Transport (DfT) data to ensure that robust information was used for these road links.

Data from count points (at which total AADT was taken from manual counts by DfT) were used for relevant roads in two categories:

(a) Roads that did not have data in the original core model, and

(b) Roads that were included in the original core model.

On road links where there were DfT counts as well as core model data, two scaling factors were produced:

- A scaling factor to scale 2018 DfT count data on the road link to the 2034 baseline (BL) AADT; and
- A scaling factor to scale 2018 DfT count data on the road link to the 2034 DM AADT.

Three DfT count points on relevant road links were used to produce three separate sets of scaling factors, with each set containing a 2034 BL and 2034 DM factor. The roads without core SRTM data were then assigned the most relevant set of scaling factors, based on expert opinion and taking into account road type and neighbouring links.

As DfT count data is downloaded in total AADT, scaling factors were produced using total AADT numbers from the core model (the sum of AADT in both directions). The scaling factors were applied to total AADT for the road link, then 50% was assigned to each direction. Some road links had no core model data and no DfT count point from which to achieve a scaled AADT. In this case, AADT for each direction was extrapolated from a nearby link to complete the dataset. In some cases, where roads branch off, a slight overestimate of AADT on the link is likely.

2.3.5 Traffic speed data

For the marginal and buffer links, 24 hour averaged speed data was not included in the original model. For these links, the 12 hour averaged speed data from the transport model was applied to the road link and a sense-check completed against neighbouring links with core model data.

2.3.6 Fleet composition

The SRTM provides a fleet composition breakdown into cars, light goods vehicles (LGVs), heavy goods vehicles (HGVs) and buses. NAEI (National Atmospheric Emissions Inventory) fleet split information can be used to further split cars into petrol and diesel categories, and HGVs into rigid HGV and articulated HGV categories, based on national average fleet composition information and depending on whether the road link is categorized as rural, urban or motorway. For this study, SRTM AADT numbers for cars and HGVs were further categorized based on mapping the SRTM road types onto the NAEI road types as shown in Table 2-1. Non-motorway SRTM road types (i.e., A road, B road, shopping, buffer and other) were categorized as either rural or urban based on their location as compared to the 2011 Area Classifications for Output Areas (2011 OAC).[15]

The fleet composition in Table 2-1 was calculated using the most recent set of NAEI fleet projection information available at the time of commission (base year 2018, published December 2018).[16] The UK

[15] The National Archives, “2011 Area Classifications”, http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/ns-area-classifications/ns-2011-area-classifications/index.html, accessed 01/07/2019.

[16] National Atmospheric Emissions Inventory, “Emission factors for transport”, http://naei.beis.gov.uk/data/ef-transport, accessed 16/07/2019.

government has published a UK Air Quality Plan in 2017[17] and a draft UK Clean Air Strategy in 2018.[18] Both of these publications reaffirm the UK government's intention for the sale of new conventional petrol and diesel cars and vans to end by 2040, and for almost every car and van on the road to be a zero emission vehicle by 2050.[19] If the UK government is to achieve these objectives, by 2023 the proportion of full plug-in electric vehicles in the national fleet would likely be greater than the current fleet projection data indicates. Hence if the government is successful in its strategy, and the proportion of electric vehicles in the national fleet is greater in 2023 than indicated in Table 2-1, the transport pollutant emissions and resulting pollutant concentrations modelled in this study for the 2023 scenario are likely to be overpredicted to some extent.

Table 2-1 Matching SRTM fleet composition to EFT vehicle types for 2023 model scenarios

NAEI Road Type	Petrol Car	Diesel Car	Electric Car	Rigid HGV	Articulated HGV
Urban (not London)	53.40%	46.04%	0.55%	75.03%	24.97%
Rural	46.92%	53.08%	–	50.74%	49.26%
Motorway	35.96%	64.04%	–	30.23%	69.77%

2.3.7 Emission factors

Vehicle emission factors for oxides of nitrogen (NOx) were obtained from COPERT v5 emission functions.[16] Vehicle emission factors for ammonia (NH_3) were obtained from the EMEP/EEA air pollutant emission inventory guidebook.[20] Link specific emission factors were calculated with our in-house emission calculation tool RapidEMS, which links directly to our RapidAIR dispersion modelling system.

The input for RapidEMS consists of a basic fleet split based on vehicle categories (diesel cars, petrol cars, LGVs, articulated HGVs, rigid HGVs, and buses) according to the traffic activity information specified in Section 2.3.6. RapidEMS is used to provide a more detailed parameterization of vehicle fleets in 2023, including all vehicles up to and including Euro 6/VI.

2.3.8 Meteorological data

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[21] and upper air data is downloaded from the NOAA Radiosonde database[22]. Meteorological data for 2014 was used in the study in order to enable the PfSH model validation to be adopted for this study.

For this study, 2014 surface meteorological data was obtained from three stations (Southampton, Wittering and Thorney Island) and upper air meteorological data was obtained from two stations (Larkhill and Herstomonceux). RapidMET was used to carry out data filling where necessary according to the methodology provided by the USEPA in their "Meteorological Monitoring Guidance for Regulatory

[17] UK Department for Environment, Food & Rural Affairs, "Air quality plan for nitrogen dioxide (NO2) in UK (2017)", https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017, accessed 01/07/2019.

[18] Department for Environment, Food & Rural Affairs, "Clean Air Strategy 2018", https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/, accessed 01/07/2019.

[19] Ultra low emission vehicles: evidence review of uptake in the UK (2015), https://www.gov.uk/government/publications/ultra-low-emission-vehicles-evidence-review-of-uptake-in-the-uk

[20] European Environment Agency, "EMEP/EEA air pollution emission inventory guidebook 2016", https://www.eea.europa.eu/publications/emep-eea-guidebook-2016, accessed 01/07/2019.

[21] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

[22] https://www.esrl.noaa.gov/roabs/

Modelling Applications" guidance document[23]. Data gaps from the primary meteorological stations (Southampton and Larkhill) are first filled using data from the other nearby stations (Wittering and Thorney Island for surface stations, and Herstomonceux for the upper air station). Remaining data gaps were filled based on the persistence method, where a missing value is replaced by the use of data from the previous hour(s), for data gaps up to and including three hours.

2.3.9 Reference year modelling and model verification

This section provides a summary of the model verification process and the derivation of linear adjustment factors to improve model performance. A more detailed description of the model verification process is presented in Appendix 1.

2.3.9.1 Oxides of nitrogen (NOx) and nitrogen dioxide (NO_2) model verification and adjustment

The model verification process for NOx and NO_2 is described in full in the PfSH AQIA report[7]. A combination of automatic monitoring and diffusion tube NO_2 measurements (173 in total) was used for model verification. The modelled vs measured concentrations at each of the monitoring locations were compared. Refinements were subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of 1.3057 was calculated for the road emissions component of the NOx model (see Appendix 1).

Total NOx was calculated as the sum of the adjusted NOx road contribution from RapidAIR and the Defra 2014 background maps (with main road sources removed from the background map). Total NO_2 concentrations were derived using the following equation (see Appendix 1 for further details):

$$(NO_2 \text{ in } \mu g/m^3) = -0.0021(NOx \text{ in } \mu g/m^3)^2 + 0.7187(NOx \text{ in } \mu g/m^3)$$

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that an RMSE of up to 4 $\mu g/m^3$ is ideal, and an RMSE of up to 10 $\mu g/m^3$ is acceptable. In this case the RMSE was calculated at 8.6 $\mu g/m^3$, which is acceptable, and reasonable for a modelling study over such a large geographical region.

2.3.9.2 Ammonia (NH_3) model verification and adjustment

There are no monitoring locations for NH_3 located within the Fareham study area, and it was therefore not possible to compare measured vs modelled concentrations for NH_3. We have adopted an approach based on Section 7.527 of the Technical Guidance LAQM.TG(16)[24] which suggests that, in the absence of measured data for model verification of a traffic pollutant, it may be appropriate to apply the adjustment factor derived from another traffic pollutant to the pollutant that does not have any monitoring data available.

In order to adopt a precautionary approach, and as particulate matter (PM_{10}) monitoring data was available for the Fareham study area, the adjustment factor for PM_{10} in the study area was also determined and compared to the adjustment factor derived for NOx/NO_2. The model verification process for PM_{10} is described in full in the PfSH AQIA report[7].

Automatic particulate matter (PM_{10}) monitoring measurements were used for model verification. A total of six PM_{10} measurements were obtained from the Annual Status Reports (ASRs) of Gosport, Portsmouth and Southampton.

The initial comparison between modelled and measured PM_{10} concentrations indicated that the model was under-predicting the PM_{10} arising from road emissions at most locations. Refinements were

[23] United States Environmental Protection Agency, "Meteorological Monitoring Guidance for Regulatory Modelling Applications" available via https://www3.epa.gov/scram001/guidance/met/mmgrma.pdf , accessed June 2019.

[24] Department for Environment Food & Rural Affairs, "Local Air Quality Management Technical Guidance (TG16)", https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf, February 2018.

subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of 3.8962 was calculated for the road emissions component of the PM_{10} model (see Appendix 1).

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted PM_{10} annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). In this case the RMSE was calculated at 6.5 µg/m^3, which is acceptable, and reasonable for a modelling study over this large of a geographical region.

Of the two linear bias adjustment factors derived above, the adjustment calculated for PM_{10} (3.8962) is larger and therefore more conservative. RapidAIR was used to generate a map of NH_3 concentrations arising from road traffic sources across the Fareham study area at a 3 m x 3 m resolution, and these values were subsequently multiplied by 3.8962 to obtain adjusted NH_3 road contribution values.

There are no background maps available for NH_3 concentrations, and therefore total NH_3 concentrations could not be modelled. This does not affect the analysis of air quality impacts at designated sites, as it is the development contribution to traffic emissions that is of interest in this study, rather than the total concentration of NH_3.

2.3.10 Future scenario modelling

2.3.10.1 Airborne pollutant concentrations

For the two future scenarios (Fareham 2023 DN and Fareham 2023 DM), RapidAIR was used to generate pollutant concentration map across the entire Fareham study area at a 3 m x 3 m resolution. These maps were generated using traffic activity data from the appropriate future scenario, emission factors calculated using RapidEMS, and 2014 meteorological data.

Pollutant concentration maps for road-only contributions (NOx, NO_2, and NH_3) were calculated using the adjustment factors described in Section 2.3.9. Maps for total pollutant concentrations (NOx and NO_2) were calculated by adding the road-only concentration maps to the appropriate pollutant background map from the LAQM website.

2.3.10.2 Pollutant deposition

Dry deposition rates of nutrient nitrogen and acid were calculated by multiplying the ground level air concentration of the appropriate pollutants (road contribution only) by the appropriate deposition velocity, followed by multiplication with a conversion factor.
Deposition velocities and conversion factors were obtained from Environment Agency guidance,[25] and are provided in Table 2-2 and Table 2-3 respectively.

Table 2-2 Deposition velocities for NO_2 and NH_3

Pollutant	Vegetation type	Deposition velocity (m/s)
NO_2	Grassland (sites with short vegetation)	0.0015
	Woodland / Forest (sites with tall vegetation)	0.003
NH_3	Grassland (sites with short vegetation)	0.02
	Woodland / Forest (sites with tall vegetation)	0.03

[25] Environment Agency, "AQTAG06: Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air," March 2014

Table 2-3 Dry deposition conversion factors

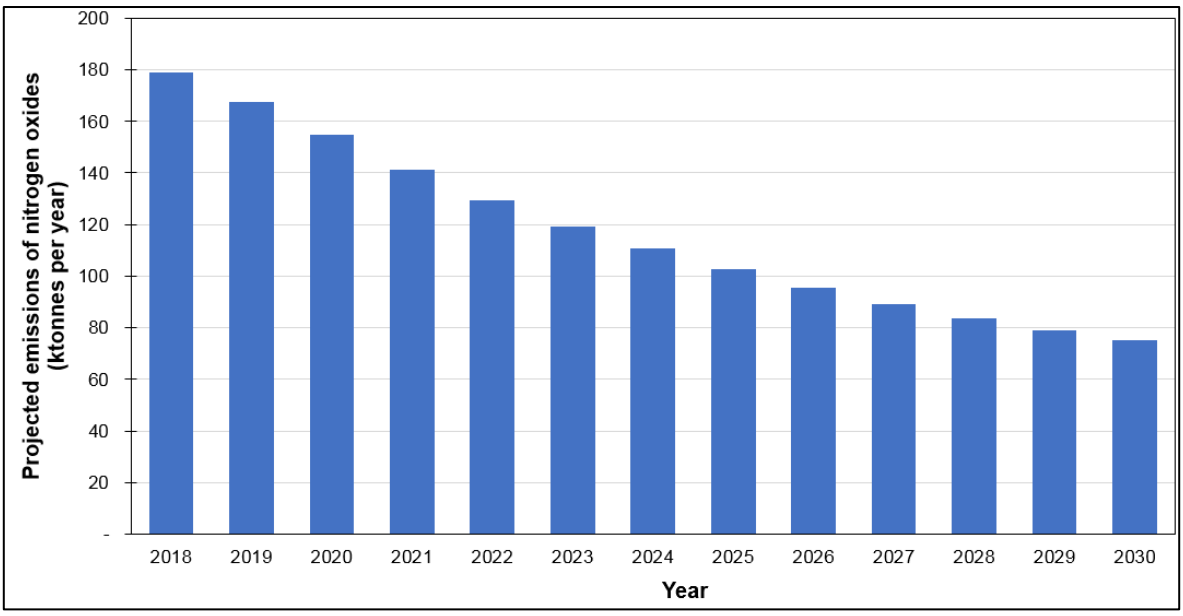
Pollutant	Conversion factor for nitrogen deposition (from µg/m²-s to kgN/ha-year)	Conversion factor for acid deposition (from µg/m²-s to kEq/ha-year)
NO_2	95.9	6.84
NH_3	260	18.5

2.3.11 Model years and considerations

This study assesses air pollution concentrations across the Fareham study area for two future scenarios in 2023. The 2023 scenarios correspond to the end of the short-term development period leading up to the anticipated adoption of the FBLP 2036. A comprehensive analysis of the air quality impacts of the FBLP development will be presented in the 2036 development scenarios in the forthcoming study.

The model results for future scenarios are particularly important to understand in the context of declining NOx emissions. Figure 2-4 presents projected road emissions of NOx for approximately 9,000 major UK roads from 2018 to 2030. The emissions in this figure are extracted from the Streamlined Pollution Climate Mapping model (SL-PCM)[26] for the baseline projection scenario, which assumes no further action beyond air quality measures that were committed across the UK by 2015. Although the emissions correspond to a subset of the UK's road network, the decrease in annual NOx emissions is indicative of the expected trend in NOx road emissions going forward, reflecting anticipated improvements in Euro emissions standards as well as changing vehicle fleet composition.

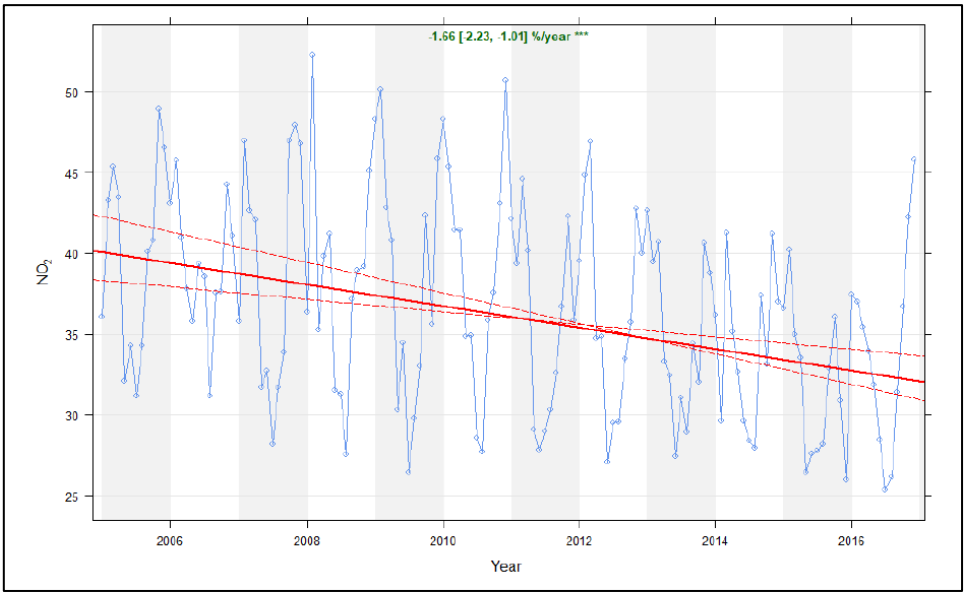
Figure 2-4 Projected road emissions of nitrogen oxides (NOx) in ktonnes per year for major UK roads



Indeed, reductions are already being realised. In the study "Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2016"[27] an analysis of NO_2 and NOx concentrations measured across the UK showed that a reduction in concentrations of approximately 1.7% per year has been seen on average between 2005 and 2016. Figure 2-5 presents results for monitoring sites in Southern England and Wales. The plot shows the best fit linear trend line, together with the lines representing the 90% confidence interval. The figure demonstrates a 1.66% reduction per year.

[26] SL-PCM has been developed specifically to model the effect of changes in fleet composition on NO_x emissions and NO_2 concentrations. See https://uk-air.defra.gov.uk/library/no2ten/2017-no2-projections-from-2015-data, accessed 01/07/2019.
[27] Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2016, Air Quality Consultants, 2018. http://www.aqconsultants.co.uk/AQC/media/Reports/NO2-NOx-Trend-Report.pdf

Figure 2-5. Overall NO_2 Trend across All Sites in Southern England and Southern Wales, with TheilSen Fit (% per yr)



2.3.12 Sources of model uncertainty

There are a number of sources of model uncertainty inherent in this type of study, as discussed below:

- A monitoring site used to derive the linear adjustment factor might be located next to a large car park, bus stop, petrol station, or taxi rank that has not been explicitly modelled due to unknown activity data. This would have the effect of artificially inflating the calculated adjustment factor, resulting in an over-prediction of impacts. Where we have identified such locations, we have removed these from the model verification process.
- A monitoring site used to derive the linear adjustment factor might be located in an area where not all of the road sources contributing to pollutant concentrations have been modelled, i.e. at a junction. This would have the effect of artificially inflating the calculated adjustment factor, resulting in an over-prediction of impacts.
- Uncertainties in the amount and distribution of development accounted for in the SRTM modelling. Household projections are revised from time to time and may vary from the values included in the SRTM model. It should also be noted that the SRTM accounts for development growth and associated increases in background traffic within the core, marginal and buffer regions of the model (see Section 2.2.1). However, there will also be future development in the 'external' region that has not been modelled explicitly by the SRTM. Furthermore, the amount and distribution of development described in the 2016 PfSH Spatial Position Statement,[28] upon which the PfSH modelling scenarios used for some of the in-combination assessment were based, will be subject to refinement as individual local plans are developed in further detail.
- Uncertainties due to the need to extend the SRTM model to cover the full area of potential concern, as described in Section 2.3.4. The SRTM model was supplemented with traffic data obtained from the DfT, which is considered to be the best available data for use in this situation.
- Uncertainties in the traffic model outputs on modelled road links, with regards to number of vehicles, type of vehicles and vehicle speed. The number of low emission vehicles in the future

[28] Partnership for Urban South Hampshire, "PUSH Spatial Position Statement", June 2016, https://www.push.gov.uk/wp-content/uploads/2018/05/PUSH-Spatial-Position-Statement-2016.pdf, accessed 01/07/2019.

development scenarios may be underestimated if the UK government is successful in ending the sale of all conventional diesel and petrol cars and vans by 2040, which could result in a systematic over-estimation of future air quality impacts.

- Uncertainties in the real-world emissions from Euro 6/VI vehicles. Early real-world emission test results of Euro 6 vehicles indicate mixed results, ranging from vehicles which met the Euro 6 standards under real-world driving emissions to vehicles which displayed NOx emissions up to 12 times higher than the Euro 6 standard.[29,30] However, the increasing use of real-world emissions tests is likely to intensify pressure on vehicle manufacturers to comply with more stringent Euro standards. If real-world emissions do not decrease as anticipated, Fareham Borough Council may wish to review the current study in the context of updated emission parameters at some point in the future.
- Uncertainties in the background maps used to develop model adjustment factors and predict total modelled concentrations, with regards to other sources of pollution, such as industrial sources, domestic heating, port activity and forest fires.
- Uncertainties resulting from the lack of monitoring data for ammonia (NH_3). We have adopted a conservative approach in our analysis by using the higher of the two model adjustment factors we derived. This is expected to result in an over-prediction of the impacts associated with NH_3, including airborne NH_3 concentrations, nitrogen deposition and acid deposition. The incorporation of monitoring data for NH_3 would result in a more robust model.
- Uncertainties in the dispersion modelling process. These are accounted for so far as possible through the model verification process, but there inevitably remain some differences between modelled concentrations and the levels that would be measured in practice.

2.4 Assessment of impacts on designated sites

The assessment of impacts on sites designated for nature conservation was carried out in a stepwise process, designed to comply with Natural England's emerging requirements[3] and good practice for evaluation of the impacts of air pollution on nature conservation sites[31].

2.4.1 Consideration of whether the proposed development could give rise to emissions which are likely to reach a designated site

Established guidance from Natural England and Highways England indicates that protected sites falling within 200 metres of the edge of a road affected by a plan or project need to be considered further.

This assessment avoids the need for relying on the assumption of a 200-metre zone of influence by including dispersion modelling of emissions from all roads with modelled traffic flows within the Fareham study area, whether or not they are located within 200m of a designated site. All potentially relevant designated sites located within 10km of Fareham Borough were included in the subsequent stage, as were roads traversing the New Forest designated sites. This approach ensured a robust assessment without relying on a distance-based screening criterion, and provided a more detailed and complete assessment for each relevant designated site.

Designated sites located within the Fareham study area are presented in Figure 2-6, Figure 2-7 and Figure 2-8.

[29] The Real Urban Emissions Initiative, https://www.trueinitiative.org/, accessed 01/07/2019.

[30] Emissions Analytics, EQUA Index, https://equaindex.com/equa-air-quality-index/, accessed 01/07/2019.

[31] Institute of Air Quality Management (IAQM), "A guide to the assessment of air quality impacts on designated nature conservation sites", Version 1.0, June 2019.

Figure 2-6 Ramsar sites and SPAs located within the Fareham study area

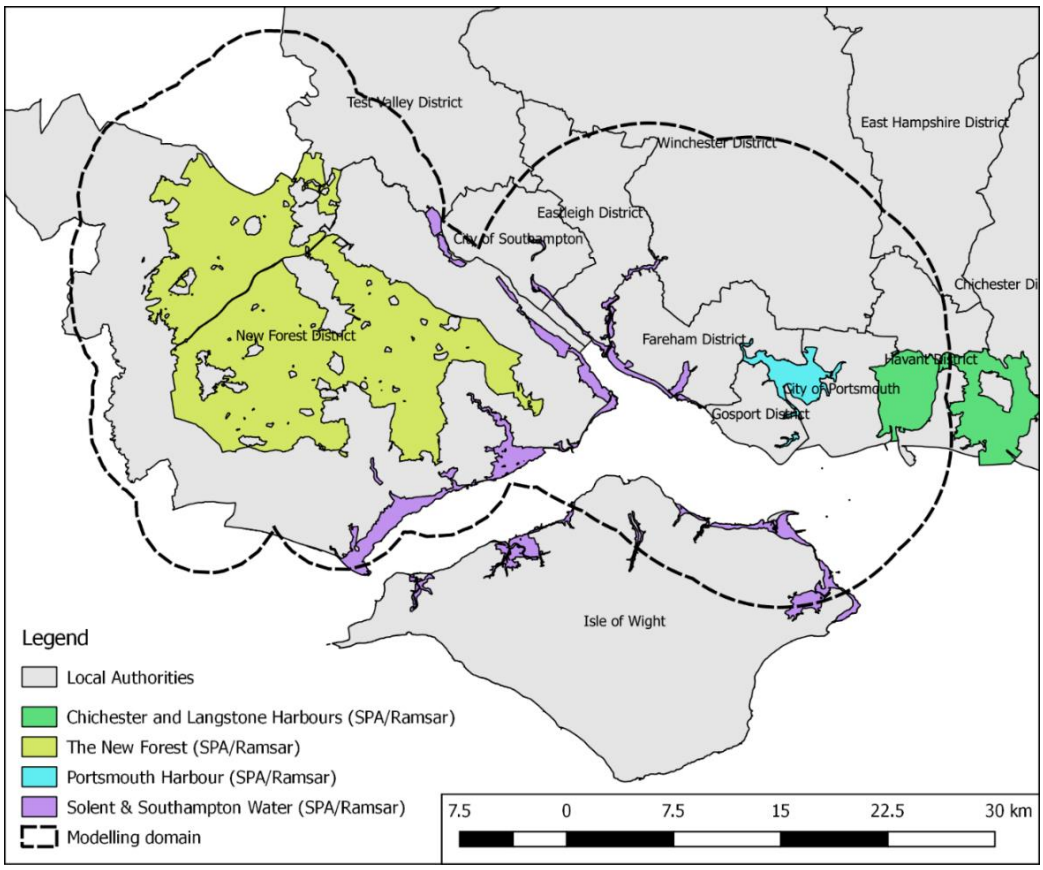


Figure 2-7 Potential SPA located within the Fareham study area

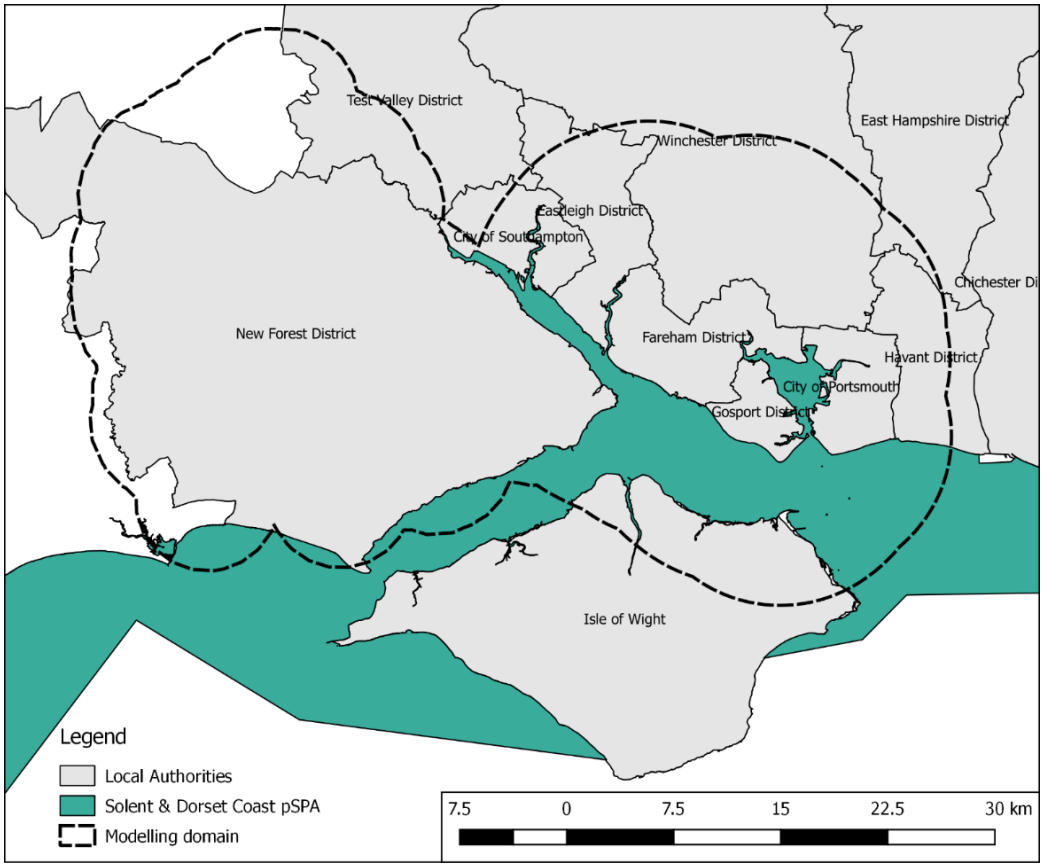
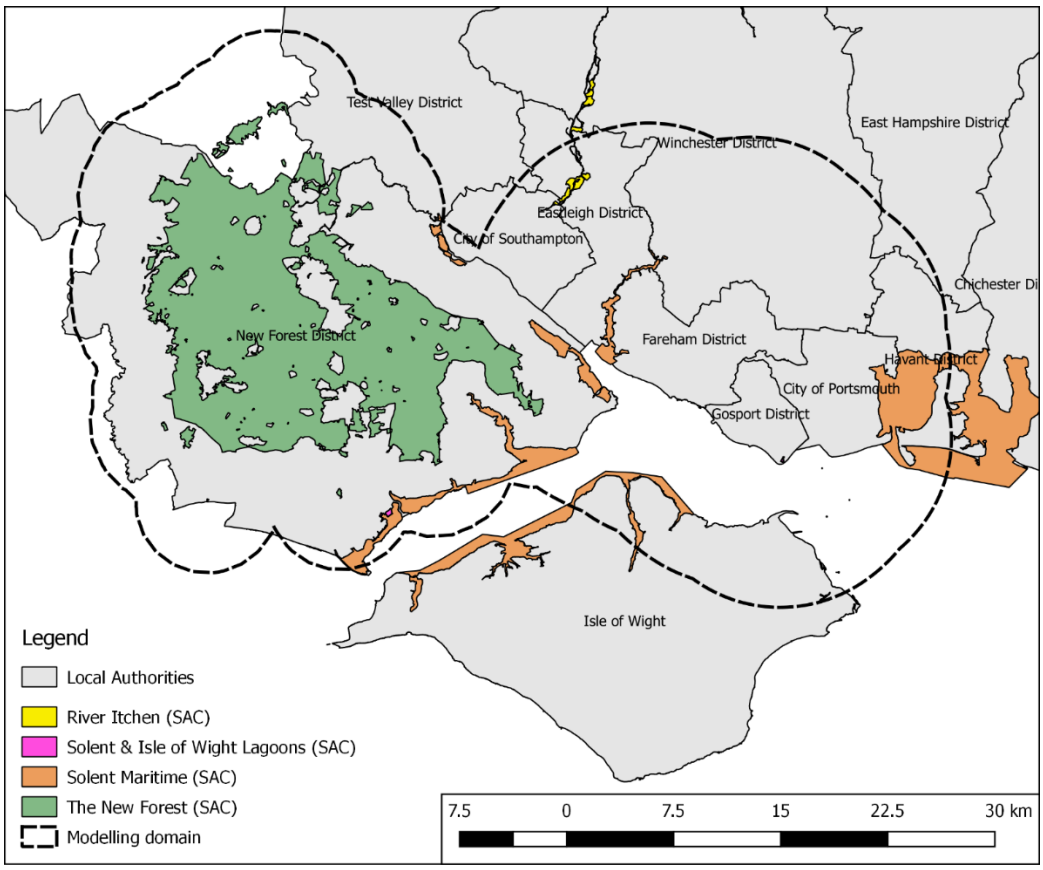


Figure 2-8 SACs located within the Fareham study area



2.4.2 Consideration of whether the qualifying features of the designated site are sensitive to air pollution impacts

Consideration was given to whether the designated site contains qualifying features that are sensitive to the emissions associated with the planned development. For increased road traffic resulting from the proposed development, the associated emissions include nutrient nitrogen deposition, acid deposition, airborne oxides of nitrogen (NOx) and airborne ammonia (NH_3).

Site screening was carried out by searching for information on the UK Air Pollution Information System (APIS, www.apis.co.uk) and identifying potential sensitivity to air pollution impacts. At this stage, the spatial distribution of qualifying features within each designated site was not considered. If a potentially sensitive feature was identified at the designated site, as determined by APIS listing a critical load or critical level for at least one pollutant associated with road traffic at that site, it was included in the subsequent stages of the study. Otherwise, the site was screened out of requiring further assessment. The results of this analysis are summarised in Table 2-4.

Consideration was also given to whether potential impacts on “functional linked land” should be considered: that is, a zone surrounding the designated site which plays a role in supporting the habitats and/or species for which each site was designated. In view of the nature of the specific designated sites under consideration in this study, and their qualifying features, there was no requirement to consider functionally linked land in an assessment of potential air quality impacts of the proposed development in the PfSH study area, which includes Fareham.

Table 2-4 European-designated sites: Assessment of sensitivity to emissions from road traffic

Site name	Ramsar site code	SPA site code	SAC site code	Does the site contain qualifying features that are sensitive to emissions from road traffic?
River Itchen (SAC)			UK0012599	Yes – include in study
Solent and Isle of Wight Lagoons (SAC)			UK0017073	Yes – include in study
Solent Maritime (SAC)			UK0030059	Yes – include in study
Chichester and Langstone Harbours (Ramsar & SPA)	UK11013	UK9011011		Yes – include in study
Portsmouth Harbour (Ramsar & SPA)	UK11055	UK9011051		Yes – include in study
Solent and Southampton Water (Ramsar & SPA)	UK11063	UK9011061		Yes – include in study
Solent and Dorset Coast (potential SPA)		UK9020330		Yes – include in study
The New Forest (Ramsar, SPA & SAC)	UK11047	UK9011031	UK0012557	Yes – include in study

2.4.3 HRA Stage 1: Assessment of air quality impacts of the development against screening thresholds

The next step was to use the dispersion modelling results to predict the air quality impacts associated with changes in traffic flow resulting from short-term development in Fareham Borough. For each set of model results (nutrient nitrogen deposition, acid deposition, airborne NOx and airborne NH_3), the contribution attributable to the Fareham 2023 development scenario was calculated as follows:

(Contribution of the Fareham 2023 DM Scenario) = (Fareham 2023 DM) – (Fareham 2023 DN)

The contribution attributable to the Do Minimum scenario was then compared to a screening threshold, where the screening threshold for each pollutant / habitat combination was set to 1% of the applicable Critical Load or Critical Level. This approach is supported by online guidance published by Defra and the Environment Agency,[32] a position statement published by the Institute of Air Quality Management (IAQM), [33] and guidance previously received from Natural England.[34]

According to the position statement published by the IAQM, the 1% threshold *"was originally set at a level that was considered to be so low as to be unequivocally in the 'inconsequential' category. In other words, this can be reasonably taken to mean that an impact of this magnitude will have an insignificant effect. This would be determined as part of the HRA screening stage. Such a conclusion would eliminate the requirement to proceed to 'appropriate assessment.'*[33] The position statement indicates that the 1% criterion is intended to be a threshold below which the impact should be considered insignificant and screened out; impacts above 1% do not necessarily correspond to the onset of damage to a designated site. Impacts above 1% should be treated as potentially significant and undergo further detailed assessment.

[32] Department for Environment, Food and Rural Affairs and Environment Agency, "Air emissions risk assessment for your environmental permit", February 2016.

[33] Institute for Air Quality Management, "Position Statement: Effect of Air Quality Impacts on Sensitive Habitats," January 2016

[34] Email communication with Natural England, 12/01/2018.

In view of this guidance, a threshold of a contribution of 1% of the applicable Critical Load or Critical Level was used to screen out any areas where short-term development in Fareham Borough, alone or in-combination, would have an insignificant impact on the relevant designated site.

2.4.3.1 Consideration of in-combination effects

Recent guidance from Natural England, developed following the requirements of the Wealden Judgment, advises that the screening thresholds should be applied with consideration to impacts from individual proposed developments and with consideration to in-combination effects.

The impact of short-term development within Fareham Borough has not been assessed in isolation for this study, either in terms of individual development sites within Fareham Borough or in terms of the total anticipated short-term development within Fareham Borough (isolated from development in neighbouring local authorities). During preliminary discussions with Fareham Borough Council, it was determined that individual developers were preparing assessments of air quality impacts from their proposed development in isolation, as needed, however an overall in-combination assessment was required to comply with the HRA process. This study fulfils the requirements of the in-combination assessment.

The dispersion modelling results of the Fareham 2023 DM scenario are based on model scenarios originally developed for in-combination development within the PfSH sub-region[7], scaled to reflect anticipated development in the PfSH area up to the end of March 2023. As such, the dispersion modelling results of the Fareham 2023 DM scenario account for in-combination air quality impacts associated with road traffic emissions from anticipated short-term development within Fareham as well as in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

The NOx pollutant background maps[35] used in the air dispersion model account for existing industrial activity, including large combustion installations, airports and shipping activity. Known industrial sources are modelled explicitly in the baseline year of the background maps, and future-year background maps are derived by incorporating datasets from the UK Department for Business, Energy & Industrial Strategy (BEIS) regarding projected energy and economic activity data for various industrial sectors. The background maps therefore account for future growth in industrial sector emissions, within the limits of current government growth projections.

The current assessment does not explicitly include in-combination effects from new industrial plans and projects, particularly those which are unlikely to be included in the BEIS sector projections which underpin the background pollutant maps. There are no currently proposed major infrastructure projects which require consideration. Other new industrial plans and projects seeking planning permission will need to carry out their own in-combination assessment of effects, where applicable, as part of the HRA process.

2.4.4 HRA Stage 2: Appropriate assessment

Where the screening analysis indicated that Likely Significant Effects (LSEs) on a designated site could not be ruled out, further analysis was undertaken in the form of an HRA Stage 2 Appropriate Assessment.

2.4.4.1 Consultation

Consultation, via meetings and correspondence, was undertaken with Natural England during the appropriate assessment stage of this HRA (HRA Stage 2). This has helped to determine which potential effects require more detailed, appropriate assessment provided by HRA Stage 2, as presented in this

[35] https://uk-air.defra.gov.uk/data/laqm-background-home

report. Confirmation of the approaches used in Stage 2 have also been sought from Natural England and the results are summarised at the end of each section.

2.4.4.2 Impact assessment

This assessment considers the potentially damaging aspects of the proposed short-term development in Fareham Borough with potential effects on a European site's qualifying features and likely achievement of the conservation objectives.

The potential for adverse effect on the integrity of the site depends on the scale and magnitude of the predicted air pollution impacts, taking into account the distribution of the designated features across the site in relation to the predicted impact.

Where qualitative and/or quantitative information is available, this has been used to inform the assessment. Where this information is not available, professional judgement has been used. In some cases, the ecological functioning of the site and the likely effects are well understood and documented elsewhere, for instance in studies commissioned to inform the Habitats Directive Review of Consents. In these cases, the assessment may simply comprise a review of this information. Where there is not sufficient information to undertake the assessment, this is recorded in this report.

For designated sites which required HRA Stage 2 Appropriate Assessment, this report aims to set out, in sufficient detail for it to be transparent and understandable, what the effects of the proposed short-term development in Fareham Borough (in-combination with development in neighbouring local authorities) are likely to be on each internationally-designated site's qualifying feature, referring to relevant background documents and other information on which these judgements, which are essentially ecological judgements, rely. Guidance states that the size or complexity of the HRA Stage 2 report to inform the Appropriate Assessment will not necessarily reflect the scale of the proposed short-term development, but rather the complexity of potential effects. The length of the report may not reflect the complexity of ecological judgements made to arrive at the necessary conclusions. Very complex ecological analysis and judgements may be expressed succinctly, with detailed supporting analyses contained in appendices or clearly referenced separate documents.

2.4.4.3 NOx forecast background maps

For some designated sites considered in this HRA, forecast NOx concentrations were included in the Stage 2 appropriate assessment. These air pollution concentration maps are published by Defra and the Devolved Administrations[35]. Their main purpose is to provide estimates of background concentrations for specific pollutants, which can then be used in air quality assessments to better understand the contribution of local sources to total pollutant concentrations. The background maps and related tools are updated periodically by Defra due to updates to the underlying data, including emissions factors.

The total concentration of a pollutant is a combination of those from local emission sources (such as roads) as well as those transported into an area from further away (by the wind). If all the local sources were removed, the concentration remaining would be that from further away – this component is defined as the 'background concentration'. In many situations, the background concentration represents a significant proportion of the total pollutant concentration.

The sources included in background maps for each pollutant can be found in the 'Background Maps User Guide' published by Defra.[36] For NOx, these include: motorway sources; trunk A and primary A road sources; minor roads and cold start sources; industry sources (e.g. combustion; energy production, fossil fuel extraction); domestic sources (e.g. heating); aircraft sources; rail sources; 'other' sources (e.g. ships, off-road, other); and point sources. The source sectors are split into those emitted from

[36] Department for Environment Food & Rural Affairs, "Background Concentration Maps User Guide" https://laqm.defra.gov.uk/documents/2015-based-background-maps-user-guide-v1.0.pdf , November 2017.

within a grid square and those entering the grid square from outside. This allows the individual sectors to be subtracted from the total background, if a more detailed local assessment is required for that sector.

The UK background maps are available from UK-AIR[35]. Background pollution maps at 1km x 1km resolution are modelled by European Union (EU) Member States as part of ambient air quality directives. The modelling methodology is based on the UK Pollution Climate Mapping (PCM) approach, which is used to model the annual mean background and roadside concentrations for the whole of the UK. These background pollution maps form the basis of the local authority background maps.

The most up-to-date background maps available at the start of this study use 2015 as the reference year and are based on monitoring and meteorological data for 2015. The main source of input data is the UK National Atmospheric Emissions Inventory (NAEI) 2014 (2015 for road transport emissions). Emissions projections for non-road traffic sources in the 2015 reference year background maps are based on energy projections from the Department for Business, Energy and Industrial Strategy (BEIS). COPERT 5 NOx emission factors for road emissions are taken from the European Environment Agency (EEA). Outside London, a set of traffic activity projections from the Department for Transport (DfT) are used, whereas inside London bespoke vehicle fleet information for London provided by Transport for London (TfL) is used.

Various Supporting Tools and Processes are available to support the use of the air pollution background concentration maps in air quality assessment. These include "NO_2 Adjustment for NOx Sector Removal" (e.g. for removing road traffic sectors from NOx and NO_2 background maps) and "NOx to NO_2 Calculator" (e.g. to derive NO_2 from NOx when NOx is predicted by modelling emissions from roads).

The maps are based on a combination of validated emission inventory data, validated dispersion modelling methods, and quality assured national air quality monitoring data. As well as being used for Habitats Regulations Assessments, the maps and their supporting data are used as inputs to national and international policy development, and to demonstrate compliance with national and European regulatory requirements, and with international treaty obligations. Consequently, the data in the maps are considered to be robust and not subject to significant scientific doubt. The maps are particularly robust when used to determine background levels away from individual sources, and when considering pollutants other than airborne PM_{10} and $PM_{2.5}$, as is the case for this study.

When considering forward projections to 2023, some additional uncertainty is introduced. In order to make these projections, the technical analysis process takes into account:

- BEIS annually updated Energy Projections;
- National (Emission Factor Toolkit) and European (COPERT) projections for vehicle exhaust emissions;
- Traffic projections produced by Department for Transport and Transport for London; and
- Foreseeable changes in industrial activity and emissions, having regard to European directives on industrial process emissions.

As with the mapped data, all these inputs to the projections are also used as inputs to national and international policy development, and to ensure future compliance with national and European regulatory requirements, and international treaty obligations. Consequently, the data in the mapped projections are considered to be robust and not subject to significant scientific doubt.

2.4.4.4 Incorporated mitigation measures

The HRA Stage 2 assessment of effects takes into account any mitigation measures that may already be specified as part of the short-term development (i.e. that are 'incorporated'), to determine whether they will most likely reduce the likelihood, magnitude, scale, and/or duration of the effect to a lower

level. These measures can include both avoidance and reduction measures, with the former being the preferred option.

2.4.4.5 Conservation objectives

The Habitats Regulations require that the Appropriate Assessment is of "the implications for the site in view of that site's conservation objectives." The development of conservation objectives is required by the 1992 'Habitats' Directive (92/43/EEC).

The generic conservation objectives coving all the European sites assessed in this report are:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species;*
- *The structure and function (including typical species) of qualifying natural habitats;*
- *The structure and function of the habitats of qualifying species;*
- *The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;*
- *The populations of qualifying species; and*
- *The distribution of qualifying species within the site.*

Site-specific conservation objectives are summarized for each designated site in Section 3.

2.4.4.6 Additional mitigation measures

Where the short-term development in Fareham Borough has been assessed as having a significant adverse effect by undermining the site's conservation objectives, additional mitigation may be necessary to satisfy the integrity test (Section 2.4.4.7). Such mitigation is that which is in addition to the incorporated measures described in Section 2.4.4.4 above, and which is usually imposed by a Competent Authority through enforceable conditions or restrictions.

2.4.4.7 Integrity test

The integrity test is the conclusion of the Appropriate Assessment and requires the competent authority to ascertain whether the proposed short-term development in Fareham Borough (either alone or in-combination with other plans or projects), will not have an adverse effect on site integrity. The following definition of site integrity is provided by Defra. The integrity of the site is:

"the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the level of populations of the species for which it was classified"

This report will conclude with a professional opinion on whether such a test can be met, but it is for the Competent Authority to make that decision in light of the information presented.

2.5 Limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of publication. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the completion of the short-term development in the Borough.

The HRA has been undertaken in as detailed a way as possible, using all available data sources where they exist. However, the conclusions drawn from this is necessarily limited by the age, type, coverage and availability of data.

Any uncertainties and the limitations of the assessment process are acknowledged and highlighted.

Recommendations for avoidance and mitigation measures to address the potential adverse effects on European Site integrity identified by this report are also based on the information available at the time of the assessment.

3 Assessment of air quality impacts on designated sites

3.1 Chichester and Langstone Harbours Ramsar (UK11013) and SPA (UK9011011)

3.1.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Chichester Harbour SSSI, Langstone Harbour SSSI

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 1: Two large estuarine basins linked by the channel which divides Hayling Island from the main Hampshire coastline. The site includes intertidal mudflats, saltmarsh, sand and shingle spits and sand dunes.

Ramsar Criterion 5: Assemblages of international importance: Species with peak counts in winter: 76480 waterfowl (5 year peak mean 1998/99-2002/2003).

Ramsar Criterion 6: Qualifying Species/populations (as identified at designation):

Species with peak counts in spring/autumn:	
Ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa	853 individuals, representing an average of 1.1% of the population (5 year peak mean 1998/92002/3)
Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe	906 individuals, representing an average of 2.5% of the population (5 year peak mean 1998/92002/3)
Common redshank, *Tringa totanus totanus*	2577 individuals, representing an average of 1% of the population (5 year peak mean 1998/92002/3)
Species with peak counts in winter:	
Dark-bellied brent goose, *Branta bernicla bernicla*	12987 individuals, representing an average of 6% of the population (5 year peak mean 1998/92002/3)
Common shelduck, *Tadorna tadorna*, NW Europe	1468 individuals, representing an average of 1.8% of the GB population (5 year peak mean 1998/9-2002/3)
Grey plover, *Pluvialis squatarola*, E Atlantic/W Africa -wintering	3043 individuals, representing an average of 1.2% of the population (5 year peak mean 1998/9-2002/3)
Dunlin, *Calidris alpina alpina*, W Siberia/W Europe	33436 individuals, representing an average of 2.5% of the population (5 year peak mean 1998/9-2002/3

Species/populations identified subsequent to designation for possible future consideration under criterion 6.

Species regularly supported during the breeding season:	
Little tern, *Sterna albifrons albifrons*, W Europe	130 apparently occupied nests, representing an average of 1.1% of the breeding population (Seabird 2000 Census)

The Site Improvement Plan for the overlapping SPA (Solent SIP043) states that nitrogen deposition has been identified as a pressure. Ramsar sites do not have Site Improvement Plans.

3.1.2 SPA background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Chichester Harbour SSSI, Langstone Harbour SSSI.

The site qualifies under **Article 4.1** of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season:	
Common Tern *Sterna hirundo*	33 pairs representing up to 0.3% of the breeding population in Great Britain (5 year mean, 1992-1996)
Little Tern *Sterna albifrons*	100 pairs representing up to 4.2% of the breeding population in Great Britain (5 year mean, 1992-1996)
Sandwich Tern *Sterna sandvicensis*	158 pairs representing up to 1.1% of the breeding population in Great Britain (1998)
Over winter:	
Bar-tailed Godwit *Limosa lapponica*	1,692 individuals representing up to 3.2% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

The site also qualifies under **Article 4.2** of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Over winter:	
Curlew *Numenius arquata*	1861 individuals representing up to 1.6% of the European - breeding population (5 year peak mean 1991/92-1995/96)
Dark-bellied Brent Goose *Branta bernicla bernicla*	17,119 individuals representing up to 5.7% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6)
Dunlin *Calidris alpina alpina*	44,294 individuals representing up to 3.2% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6)
Grey Plover *Pluvialis squatarola*	3,825 individuals representing up to 2.3% of the Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6)
Pintail *Anas acuta*	330 individuals representing (up to 1.2% of the North-western Europe population (5 year peak mean 1991/92-1995/96)
Redshank *Tringa totanus*	1,788 individuals representing up to 1% of the Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6)
Red-breasted Merganser *Mergus serrator*	297 individuals representing up to 3% of the North-western/Central Europe population (5 year peak mean 1991/92-1995/96)

Over winter:	
Sanderling *Calidris alba*	236 individuals representing up to 0.2% (Eastern Atlantic/Western & Southern Africa - wintering) of the Eastern Atlantic/Western & Southern Africa - wintering population (5 year peak mean 1991/92-1995/96)
Shelduck *Tadorna tadorna*	2410 individuals representing up to 3.3% of the North-western Europe population (5 year peak mean 1991/92-1995/96)
Shoveler *Anas clypeata*	100 individuals representing up to 1% of the North-western/Central Europe population (5 year peak mean 1991/92-1995/96)
Teal *Anas crecca*	1824 individuals representing up to 0.5% of the North-western Europe population (5 year peak mean 1991/92-1995/96)
Turnstone *Arenaria intrepes*	430 individuals representing up to 0.7% of the Western Palearctic – wintering population (5 year peak mean 1991/92-1995/96)
Wigeon *Anas penelope*	2055 individuals representing up to 0.7% of the Western Siberia/North-western/North-eastern Europe population (5 year peak mean 1991/92-1995/96)
Ringed Plover *Charadrius hiaticula*	846 individuals representing up to 3% of the Europe/Northern Africa - wintering population (5 year peak mean 1991/2 - 1995/6)

Assemblage qualification: A wetland of international importance:

Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl.

Over winter, the area regularly supports 93,230 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Bar-tailed godwit, curlew, dark-bellied Brent geese, dunlin, grey plover, pintail, red-breasted merganser, redshank, ringed plover, sanderling, shelduck, shoveler, teal, turnstone and wigeon.

The Site Improvement Plan (SIP043) states that nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,
- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.1.3 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-1 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this

designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-1 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Chichester and Langstone Harbours Ramsar and SPA

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Sterna sandvicensis (Western Europe/Western Africa) - Sandwich tern	**8**	**1.123**	**3**
Sterna hirundo (Northern/Eastern Europe - breeding) - Common tern	**8**	**1.123**	**3**
Sterna albifrons (Eastern Atlantic - breeding) - Little tern	**8**	**1.123**	**3**
Tadorna tadorna (North-western Europe) - Common shelduck	20	Not sensitive	**3**
Anas penelope (Western Siberia/North-western/North-eastern Europe) - Eurasian wigeon	20	Not sensitive	**3**
Anas crecca (North-western Europe) - Eurasian teal	20	Not sensitive	**3**
Anas acuta (North-western Europe) - Northern pintail	20	Not sensitive	**3**
Mergus serrator (North-western/Central Europe) - Red-breasted merganser	20	Not sensitive	**3**
Charadrius hiaticula (Europe/Northern Africa - wintering) - Ringed plover	20	Not sensitive	**3**
Pluvialis squatarola (Eastern Atlantic - wintering) - Grey plover	20	Not sensitive	**3**
Calidris alba (Eastern Atlantic/Western & Southern Africa - wintering) - Sanderling	20	Not sensitive	**3**
Limosa lapponica (Western Palearctic - wintering) - Bar-tailed godwit	20	Not sensitive	**3**
Numenius arquata (Europe - breeding) - Eurasian curlew	20	**1.123**	**3**
Tringa totanus (Eastern Atlantic - wintering) - Common redshank	20	Not sensitive	**3**
Arenaria interpres (Western Palearctic - wintering) - Ruddy turnstone	20	Not sensitive	**3**

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs ($\mu g/m^3$)
Anas clypeata (North-western/Central Europe) - Northern shoveler	No data	No data	**3**

Consideration of in-combination effects

The Chichester and Langstone Harbours Ramsar and SPA designated sites are contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-2 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All four pollutants exceeded the 1% screening threshold for the Fareham 2023 DM Scenario. On the basis of available evidence and agreed thresholds, likely significant effects from air quality impacts cannot be ruled-out. Therefore, a Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-2 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Forest	8	1.44	18.0%
	Grassland	8	0.84	10.5%
Acid deposition (kEq/ha-year)	Forest	1.123	0.10	9.1%
	Grassland	1.123	0.060	5.3%
Airborne NOx ($\mu g/m^3$)	n/a	30	5.61	18.7%
Airborne NH_3 ($\mu g/m^3$)	n/a	3	0.091	3.0%

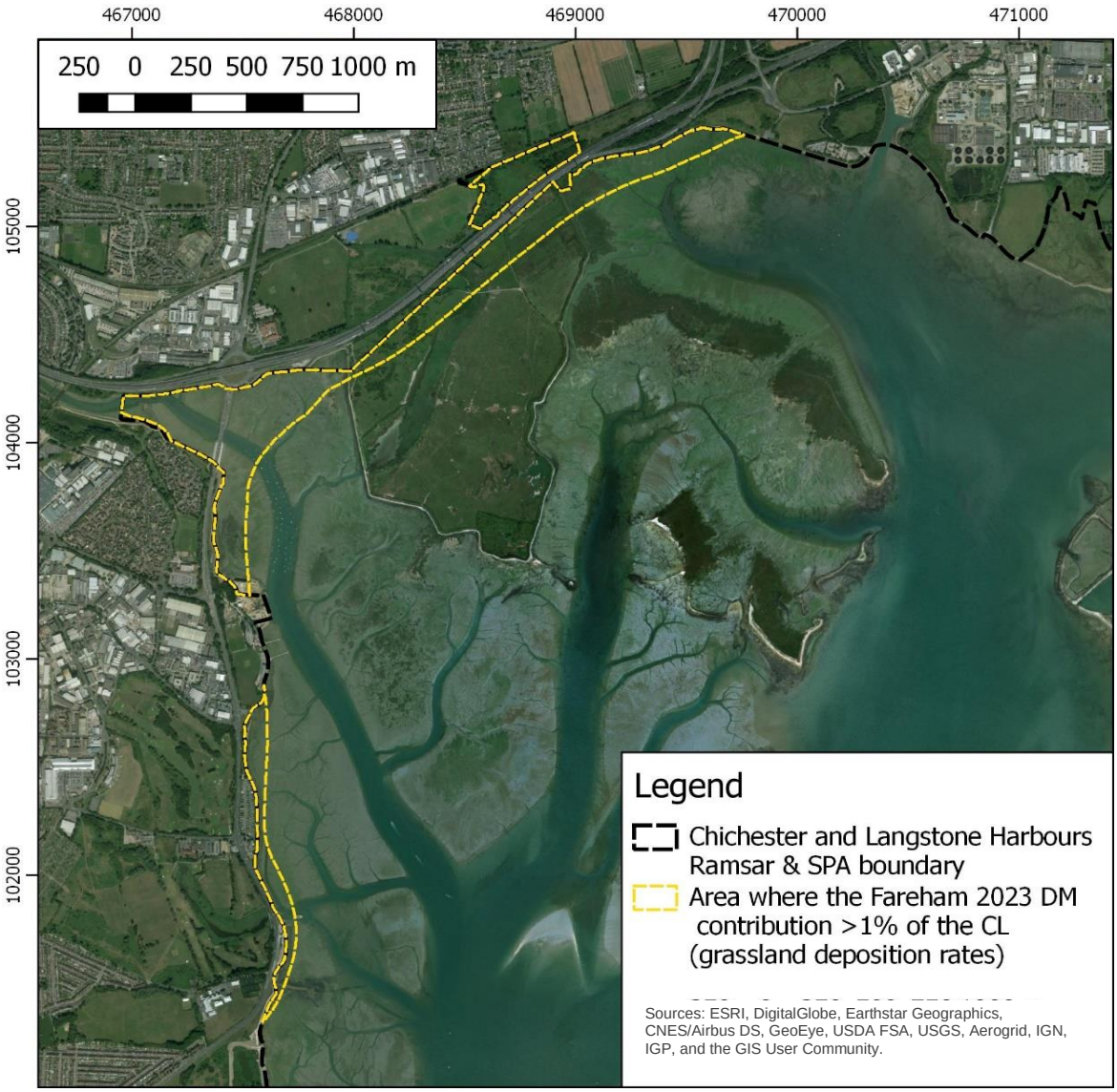
This designated site is mainly characterized by marine habitats with short vegetation, and in these areas, the grassland deposition rates are applicable. There is a wedge-shaped section of the site located north of the A27 where taller vegetation is present and where forest deposition rates are applicable.

3.1.4 HRA Stage 2: Appropriate Assessment

3.1.4.1 Nitrogen deposition

Figure 3-1 illustrates the areas where the modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL). Three areas of exceedance were identified, two near the A27, and one further south.

Figure 3-1 Overview of screening results for nitrogen deposition at Chichester and Langstone Harbours Ramsar & SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year



Summary of critical loads

The lowest Critical Loads are listed for potential impacts to the three species of tern (Sandwich Tern, Common Tern and Little Tern) due to impacts to their broad habitats.

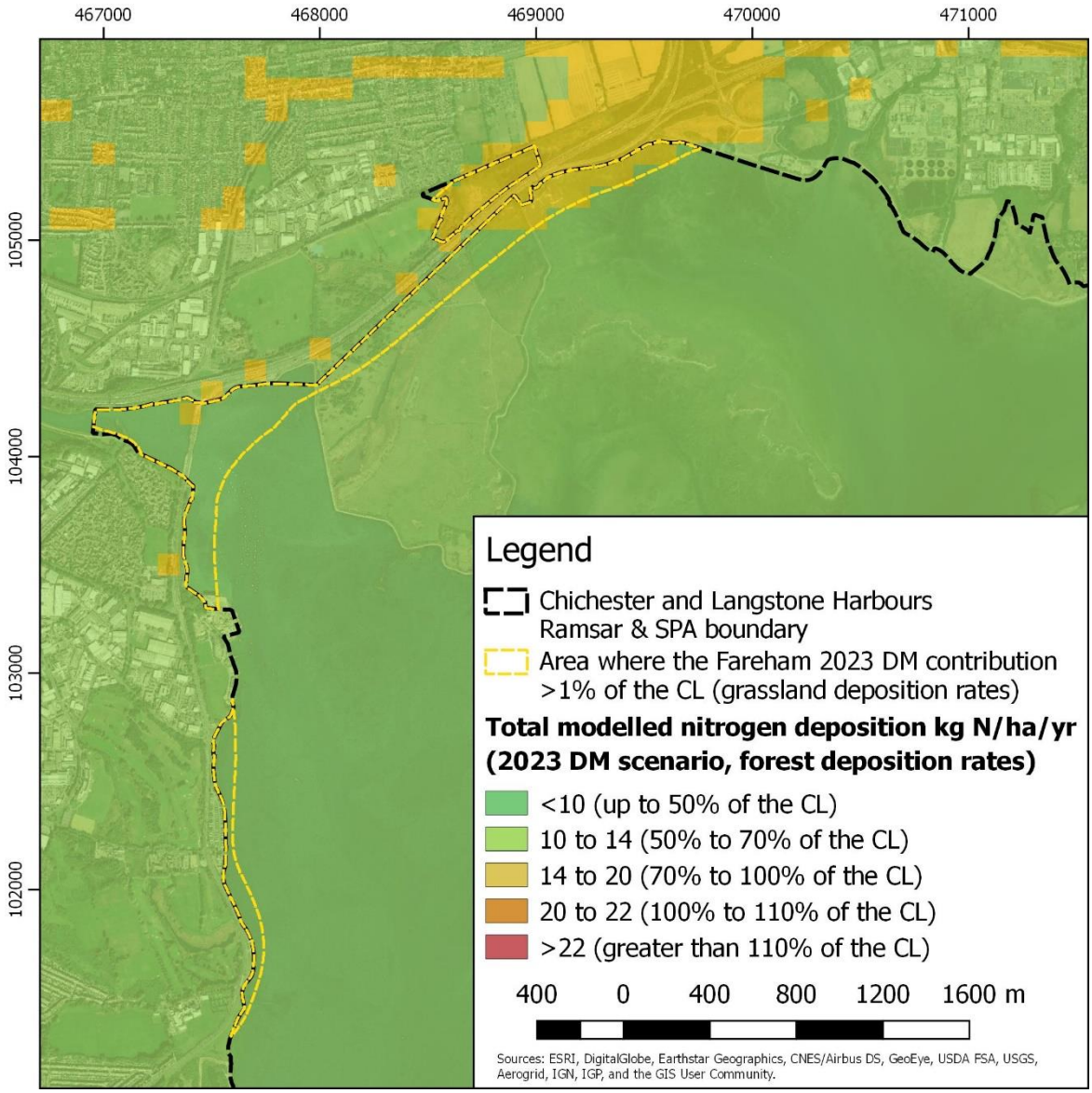
- 8 – 10 kgN/ha-year for Coastal stable dune grasslands (acid type)
- 10 – 20 kgN/ha-year for Shifting coastal dunes
- 10 – 15 kgN/ha-year for Coastal stable dune grasslands (calcareous type)

A higher CL of 20 – 30 kgN/ha-year applies for other birds and their associated habitats, such as Common shelduck, with a broad habitat type of pioneer, low-mid, mid-upper saltmarshes.

Figure 3-1 shows the areas where the DM contribution of nitrogen deposition is predicted to exceed 1% of the screening threshold (the lowest CL, 8 kgN/ha-year). For those areas predicted to exceed the 1% screening threshold, APIS indicates that the current background nitrogen deposition[37] ranges from 12.88 to 13.86 kgN/ha-year.

The model results predict that the highest contributions from the Fareham 2023 DM scenario are 1.44 kgN/ha-year for areas with tall vegetation and 0.84 kgN/ha-year for areas where vegetation is short. The worst-case total predicted deposition rate, assuming a background deposition rate of 13.86 kgN/ha-year and a Fareham 2023 DM contribution of 1.44 kgN/ha-year, is 15.30 kgN/ha-year. The total nitrogen deposition is therefore predicted to be below 20 kgN/ha-year throughout the site, as shown in Figure 3-2, and based on this analysis we can conclude that there will not be an adverse effect on species or habitats where a CL of 20 kgN/ha-year is applicable.

Figure 3-2 Areas where the modelled DM contribution exceeds 1% of the CL assuming grassland deposition rates and a CL of 8 kgN/ha-year, and total modelled nitrogen deposition assuming forest deposition rates and a CL of 20 kgN/ha-year, at Chichester and Langstone Harbours Ramsar & SPA



[37] Site/Feature Information, Chichester and Langstone Harbours, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK9011011&deptype=M&featurecode=A137&accode=NSH, accessed 16/08/2019.

It should also be noted that the worst-case deposition rate of 15.30 kgN/ha-year is overly precautionary for most of the designated site, as most of the designated site is characterized by marine areas and short vegetation; the only areas with tall vegetation are located in the wedge-shaped woodland portion of the designated site located north of the A27.

The remaining assessment for nitrogen deposition in Chichester and Langstone Harbours is focused on potential impacts to the three species of tern and their supporting habitats. The relevant habitat types are indicated on APIS as being various types of sand dune. Site survey work was carried out in December 2018 in support of the Havant Local Plan HRA,[38] and covered the areas predicted to exceed the screening threshold under the Fareham 2023 DM scenario. No sand dunes were identified in the areas predicted to exceed the screening threshold.

The Solent Waders and Brent Goose Strategy[39] sets out the key foraging and roost habitat for brent geese and waders. The small area of exceedance falls outside of the key SPA sites for foraging and roosting in this locality. Based on the information available, Natural England have confirmed that the approach from Havant HRA can be adopted.[40]

On the basis of available evidence, including the absence of sensitive features in the areas of exceedance, there are no adverse effects on this Ramsar and SPA site arising from the increased nitrogen deposition associated with the Fareham 2023 DM development scenario, and therefore no further assessment is required.

3.1.4.2 Airborne NH_3

The relevant CL for Chichester and Langstone Harbours Ramsar and SPA is 3 µg/m^3 for all features. Figure 3-3 illustrates the areas where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.03 µg/m^3 (1% of 3 µg/m^3).

Consideration of background concentrations

Figure 3-4 shows the results of the Fareham 2023 DM model scenario overlaid with the 2013-2015 background NH_3 concentrations from APIS[37]. The area of exceedance of 1% of the CL is shown only, although the predicted NH_3 concentration does not exceed the CL of 3 µg/m^3 anywhere within the site boundary. In this case, the maximum total predicted concentration was 1.38 µg/m^3 (46.0% of the CL).

On the basis of available evidence, including the current background levels of ammonia, there are no adverse effects on this Ramsar and SPA site arising from increased ammonia associated with the Fareham 2023 DM development scenario, and therefore no further assessment is required.

[38] Ricardo Energy & Environment, "Air Quality Habitat Regulations Assessment for Havant Borough Local Plan 2036", Issue 3, January 2019.

[39] Solent Waders and Brent Goose Strategy, Solent Waders and Brent Goose Strategy Steering Group, November 2010, available online at: https://solentwbgs.files.wordpress.com/2017/02/solent-waders-and-brent-goose-strategy.pdf (accessed October 2019).

[40] Email from Rachel Jones, Natural England, 06/10/209.

Figure 3-3 Overview of screening results for airborne ammonia at Chichester and Langstone Harbours Ramsar & SPA, assuming a CL of 3 µg/m³

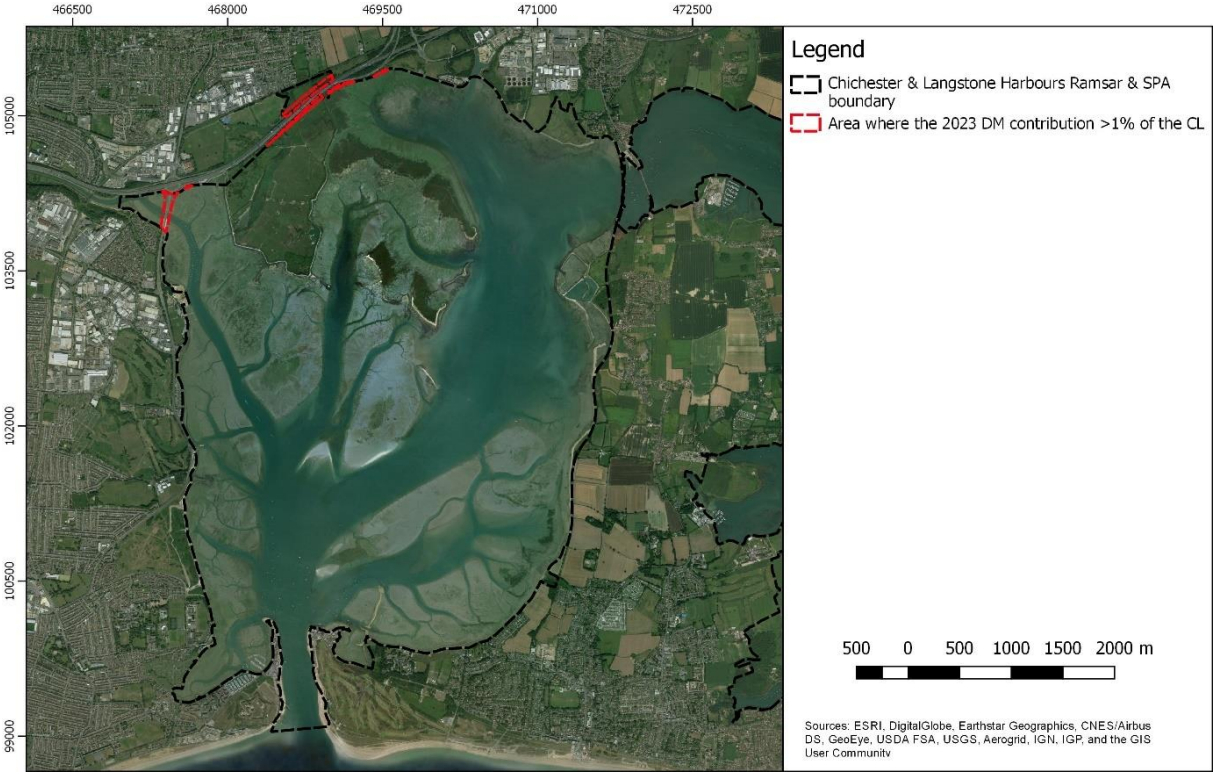
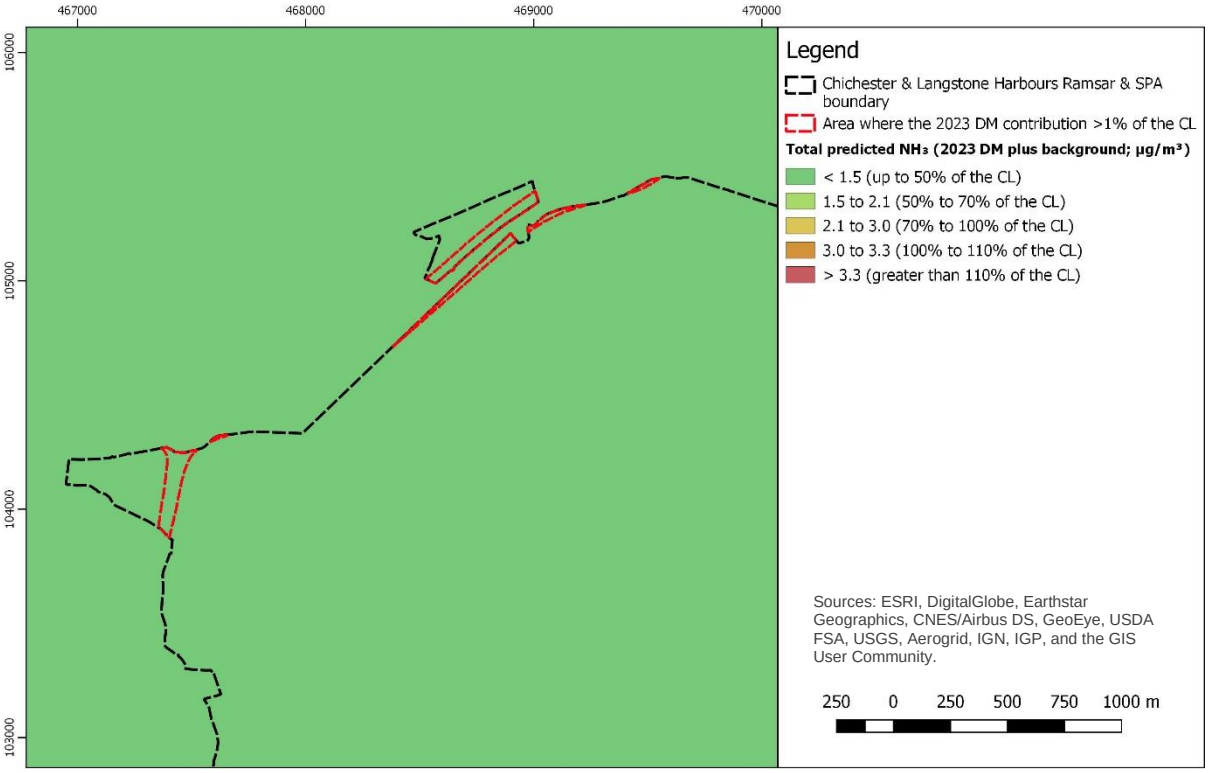


Figure 3-4 Total modelled concentrations of airborne ammonia at Chichester and Langstone Harbours Ramsar & SPA in 2023, assuming a CL of 3 µg/m³



3.1.4.3 Acid deposition

Figure 3-5 illustrates the areas where modelled contributions from the 2023 Fareham 2023 DM scenario are predicted to exceed 0.01123 kEq/ha-year (1% of the lowest CL). Six areas of exceedance were identified, three near the A27, and three much smaller areas further south.

Figure 3-5 Overview of screening results for acid deposition at Chichester and Langstone Harbours Ramsar & SPA, assuming grassland deposition rates and a CL of 1.123 kEq/ha-year

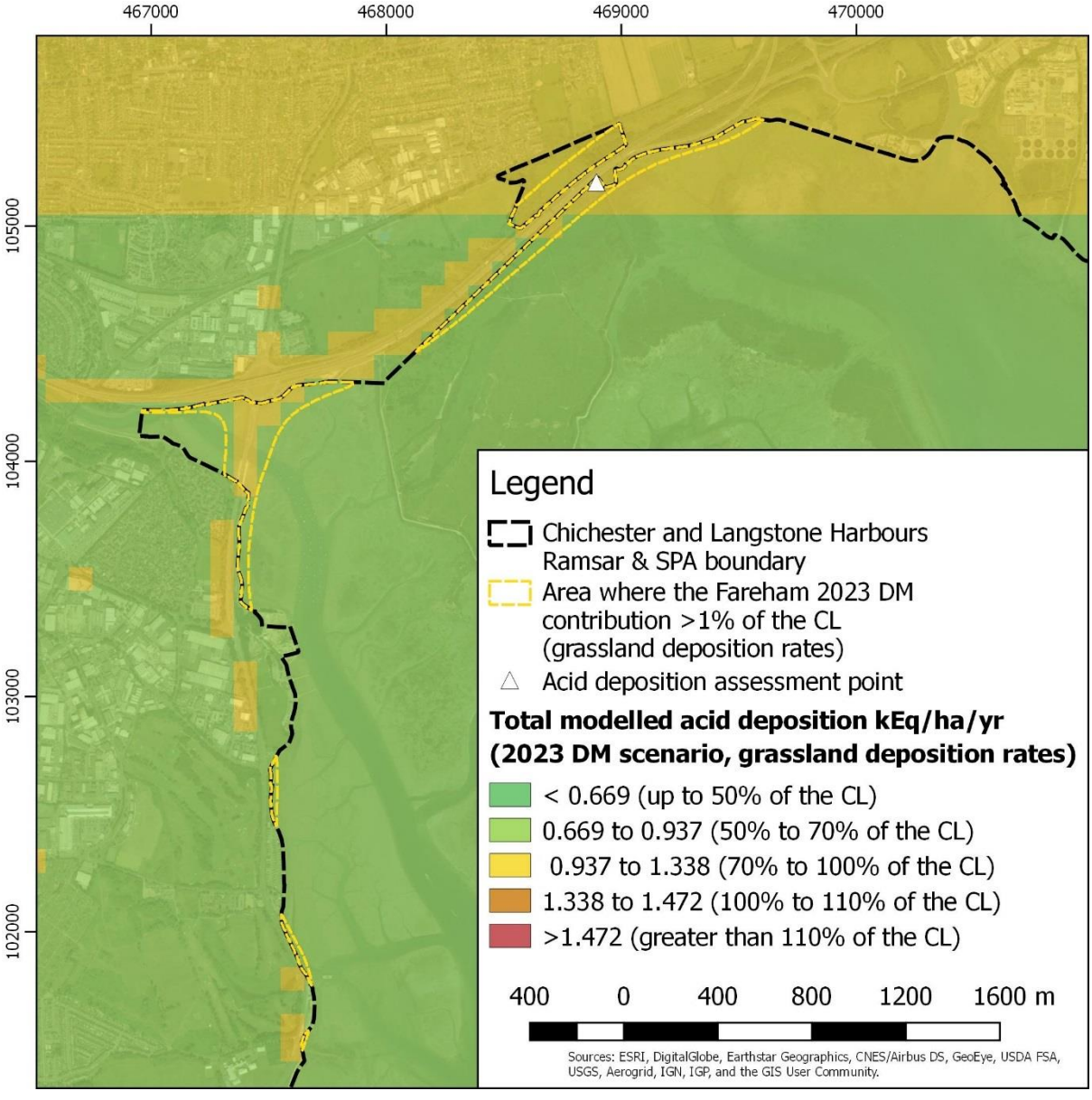
Summary of critical loads:

The Common Tern is the only species of bird listed on APIS as having a "Potential negative impact on species due to impact on the species' broad habitats". The relevant CLs are 1.123 kEq/ha-year for acid grassland, and 4.856 kEq/ha-year for calcareous grassland.

For other birds listed on APIS (Eurasian curlew, Sandwich Tern, Little Tern, Dark-bellied brent goose, Common shelduck, Eurasian wigeon, Eurasian teal, Northern pintail, Northern shoveler, Red breasted merganser, Ringed plover, Grey plover, Sanderling, Dunlin, Bar-tailed godwit, Common redshank, and Ruddy turnstone), APIS indicates "no expected negative impact on the species due to impacts on the species broad habitat".

The critical load for acid deposition varies by location, depending on factors such as local soil chemistry. The "Search by Location" tool on APIS[41] has been used to extract relevant parameters (background deposition, CLmaxS, CLminN and CLmaxN) at the highest modelled concentration adjacent to the A27, labelled in Figure 3-6, for the 'acid grassland' habitat type. The assessment parameters are listed in Table 3-3.

Figure 3-6 Areas where the modelled DM contribution exceeds 1% of the CL assuming a CL of 1.123 kEq/ha-year, and total modelled acid deposition assuming grassland deposition rates and a CL of 1.338 kEq/ha-year, at Chichester and Langstone Harbours Ramsar & SPA



Screening in Stage 1 was conducted using the minimum acid deposition CL of 1.123 kEq/ha-year. Using the "Search by Location" tool, the CL at this assessment point was determined to be 1.338 kEq/ha-year. With the location-specific CL, the Process Contribution still exceeds 1% of the CL, however, the Predicted Environmental Concentration (PEC) does not exceed 100% of the CL and was calculated as 96.4% (Figure 3-6).

[41] Air Pollution Information Systems (APIS) Search by Location tool, http://www.apis.ac.uk/search-location, accessed 18/09/2019.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this Ramsar and SPA site arising from increased acid deposition associated with the Fareham 2023 DM development scenario, and therefore no further assessment is required.

Table 3-3 Summary of acid deposition point analysis for highest modelled concentration at Chichester and Langstone Harbours Ramsar & SPA

Acid deposition analysis	Chichester & Langstone Harbours
Assessment point (Easting, Northing)	468894,105186
Rationale for assessment point	Highest modelled concentration, adjacent to the A27
Deposition rate	Grassland
PC for Fareham 2023 DM contribution (kEq/ha-year)	0.027
Background N deposition (kEq/ha-year)	0.99
Background S deposition (kEq/ha-year)	0.27
CLmaxS (kEq/ha-year; acid grassland)	0.9
CLminN (kEq/ha-year; acid grassland)	0.438
CLmaxN (kEq/ha-year; acid grassland)	**1.338**
PC as % of CL function	2.2
PEC as % of CL function	96.4
Assessment	**The PC is >1% of the CL but the PEC does not exceed the CL; no significant adverse effects are anticipated.**

3.1.4.4 Airborne NOx

The relevant CL for Chichester and Langstone Harbours Ramsar and SPA is 30 µg/m^3 for all vegetation. Figure 3-7 illustrates the area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of 30 µg/m^3).

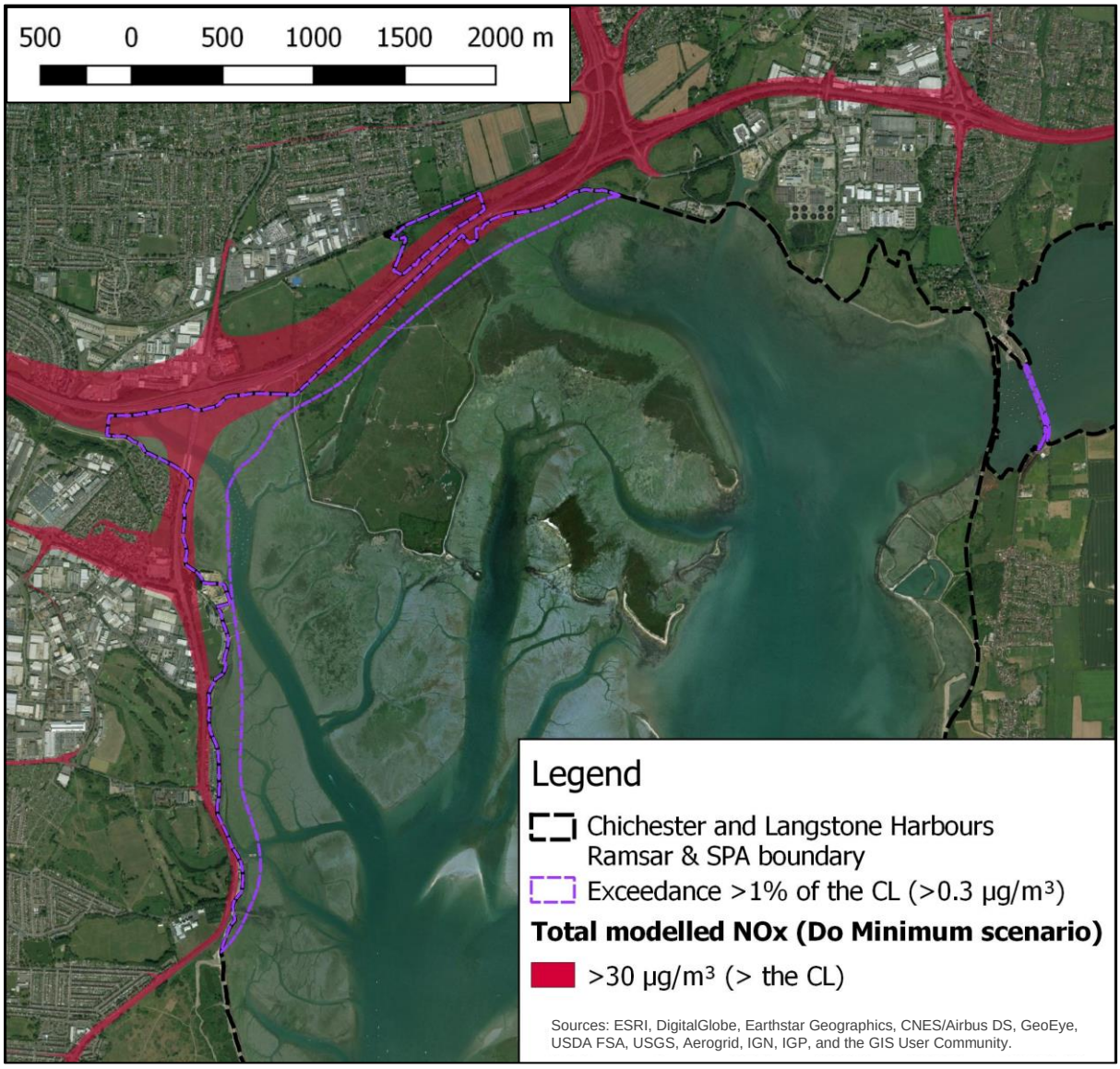
The areas which overlap with the red portions of the map, where total predicted concentrations in 2023 are >30 µg/m^3, are primarily intertidal mudflat and seagrass beds; these habitat types are regularly inundated by tidal waters and this is supported by the Mean High Water mark[42] which covers the majority of the site; in these areas air pollution impacts are not expected to be significant.

There are also small areas of habitat types which are not regularly inundated, including saltmarsh, woodland, lowland meadow, grazing marsh and scrub. Given the relatively small areas of these habitats which are predicted to experience NOx concentrations >30 µg/m^3 in 2023, compared to the wealth of larger areas of similar habitats located elsewhere within the designated site, it is not anticipated that NOx concentrations >30 µg/m^3 in the narrow bands either side of the A27 will have an adverse effect on the bird species for which this site is designated. This is analogous to the approach and conclusion in the Havant HRA regarding potential impacts on the Chichester and Langstone Harbours Ramsar and SPA.[40] As explained in the nitrogen deposition discussion (Section 3.1.4.1) Natural England have confirmed that the approach from the Havant HRA can be adopted. This analysis is supported by

[42] Regions (December 2017) Full Clipped Boundaries in England; Full resolution - clipped to the coastline (Mean High Water mark), available online at https://data.gov.uk/dataset/ff1f0c7d-acbf-4b9a-bc77-b8c0fd095070/regions-december-2017-full-clipped-boundaries-in-england (accessed 03/10/2019).

information contained in the Hampshire Biodiversity Information Centre (HBIC) and priority habitat mapping (PHI) datasets, satellite imagery, and site surveys carried out in support of the Havant HRA.

Figure 3-7 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at Chichester and Langstone Harbours Ramsar & SPA



On the basis of available evidence, including the spatial distribution of sensitive qualifying features and the total modelled concentration of NOx in 2023, there are no adverse effects on this Ramsar and SPA site arising from increased NOx associated with the Fareham 2023 DM development scenario, and therefore no further assessment is required.

3.1.4.5 Detailed consideration of qualifying features

Due to the complexity of Chichester and Langstone Harbour, each qualifying feature is considered in-turn in Table 3-4.

Table 3-4 Detailed consideration of qualifying features for Chichester and Langstone Harbours Ramsar & SPA

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
Ramsar Criterion 1: Two large estuarine basins linked by the channel which divides Hayling Island from the main Hampshire coastline. The site includes intertidal mudflats, saltmarsh, sand and shingle spits and sand dunes.	**Mudflats** No Critical Level for mudflats is provided for any of the pollutants. Mudflat habitats are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed plan are therefore not anticipated for this feature.	No
	Saltmarsh Saltmarsh is present within the areas predicted to exceed the screening thresholds of all four pollutants. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. Given saltmarsh is a supporting habitat of the qualifying bird species, the impact of increased airborne NOx concentrations upon saltmarsh is considered below for birds. <u>NOx</u> The total area predicted to exceed 30 µg/m^3 NOx in 2023 comprises a band along the A27 and a narrow band along a portion of the A2030. A review of aerial and roadside imagery, as well as site survey data indicates much of the northern extent of Farlington marshes (the area south of the A27) comprises scattered scrub, longer grasses and areas of reedbed. The entirety of the designated site comprises an area of 5810ha, and site documentation indicates that 21.4% (1243ha) of this is saltmarsh. The total area of saltmarsh predicted to experience NOx concentrations > 30 µg/m^3 in 2023, based on the HBIC dataset, is approximately 1.3ha, representing 0.023% of the saltmarsh habitat within the European site. In addition, the future modelled contribution combined with the future background level of NOx is predicted to be lower than the current background level of NOx, indicating that the air quality in 2023 will be an improvement over the current situation. The Fareham 2023 DM development scenario is considered to have no adverse effects.	No
	Sand and shingle spits Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. <u>NOx</u> The total area predicted to exceed 30 µg/m^3 NOx in 2023 comprises a band along the A27 and a narrow band along a portion of the A2030. A review of aerial and roadside imagery, as well as site survey data[38] indicates that this habitat does not occur within the identified areas of exceedance. As such, the Fareham 2023 DM development scenario is considered to have no adverse effects.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	Sand dunes This habitat is not present within the areas predicted to exceed the pollutant screening thresholds, based on several sources of information: satellite imagery, site surveys carried out in December 2018[38], GIS datasets available from HBIC, and advice from Natural England.	No
Ramsar Criterion 5: Assemblages of international importance: Species with peak counts in winter: 76480 waterfowl (5 year peak mean 1998/99-2002/2003).	No species list is provided for the Ramsar assemblage qualification however, an assemblage list is provided for the SPA designation. The impacts to all bird species listed within the SPA assemblage list are considered individually therefore any adverse impacts identified for SPA bird species would represent an adverse impact on this assemblage qualification.	No
Ramsar Criterion 6: Individual qualifying bird species.	All individual qualifying birds are considered under the SPA designation (below).	N/A
SPA Article 4.1: Little Tern	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. <u>NOx</u> BTO core count data[43] indicates no records of little tern within Langstone Harbour whereas annual records of the species have been made for the adjacent Chichester Harbour. Given the absence of the species from Langstone Harbour, any impacts to potentially suitable breeding habitat is very unlikely to cause a significant adverse impact to this species. Additionally, as discussed above, supporting habitats (types of sand dune) are not present within the areas predicted to exceed the pollutant screening thresholds. As such, the Fareham 2023 DM development scenario is considered to have no adverse effects.	No

[43] https://app.bto.org/webs-reporting/ (accessed 09/10/19)

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
SPA Article 4.1: Sandwich Tern	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx BTO core count data[43] indicates no records of little tern within Langstone Harbour whereas annual records of the species have been made for the adjacent Chichester Harbour. Given the absence of the species from Langstone Harbour, any impacts to potentially suitable breeding habitat is very unlikely to cause a significant adverse impact to this species. Additionally, as discussed above, supporting habitats (types of sand dune) are not present within the areas predicted to exceed the pollutant screening thresholds. As such, the Fareham 2023 DM development scenario is considered to have no adverse effects.	No
SPA Article 4.1: Bar-tailed Godwit	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Ringed Plover	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Dark-bellied Brent Goose	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx When considering total predicted concentrations, the area predicted to exceed 30 µg/m^3 in 2030 comprises a band along the A27 and a narrow band along a portion of the A2030. The band adjacent to the A2030 comprises intertidal mudflats, a broad habitat type which is regularly inundated by the tide and where air pollution impacts would not be expected to be significant. A review of aerial and roadside imagery, as well as site survey data indicates much of the northern extent of Farlington marshes (along the A27) comprises scattered scrub, longer grasses and areas of reedbed. These habitats are not favoured by dark-bellied Brent geese as they prefer ‘large open sites where they have clear sight lines’.[44] As	No

[44] McKay et al. 2001 Hampshire Brent Goose Strategy Group 2002 as cited in Rowell, H.E. and Robinson, J.A. Feeding areas for Dark-bellied Brent Geese Branta bernicla bernicla around Special Protection Areas (SPAs) in the UK. The Wildfowl and Wetlands Trust, Slimbridge. 2004.

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	such, it is highly unlikely that the northern areas of Farlington Marshes provide important habitat for dark-bellied Brent geese. Based on the available evidence, an adverse effect on dark-bellied Brent geese can be discounted.	
SPA Article 4.2: Dunlin	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that although the supporting habitat is sensitive to air pollutants, the species itself is not impacted through impact to habitat.	No
SPA Article 4.2: Grey Plover	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Redshank	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx: APIS indicates there is “no expected negative impact on species due to impacts on the species’ broad habitat.”	No
SPA Article 4.2: Shelduck	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx: APIS indicates there is “no expected negative impact on species due to impacts on the species’ broad habitat.”	No
SPA Article 4.1: Common Tern	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx There are two local sites within Langstone Harbour which are known to have suitable habitat for supporting tern species and for which anecdotal references to breeding terns exist. One of which is West Hayling Local Nature Reserve (LNR) which is reported as attracting breeding terns in the summer, however, this site is situated entirely outside of the areas predicted to exceed the screening thresholds for all four pollutants. The second site, Langstone Harbour Nature Reserve, an RSPB managed site, is present to the east and south-east of Farlington Marshes. Management of this site has been undertaken in the last decade to improve the quality of breeding habitat for terns, primarily aimed at encouraging little	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	terns to nest. The areas predicted to exceed the screening thresholds overlap the northern-most island within this reserve, however no suitable breeding habitat for common tern is present within this area. As such, the Fareham 2023 DM development scenario is considered to have no adverse effects.	
SPA Article 4.2: Curlew	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition or airborne NH_3. NOx Similar to dark-bellied Brent goose, curlew avoid nesting and feeding in areas close to tall shrub cover[45] therefore no significant impacts to curlew are considered likely for the same reasons as dark-bellied Brent goose above.	No
SPA Article 4.2: Pintail	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Red-breasted merganser	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx: APIS indicates that the feature’s habitat is not sensitive to NOx, and there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Sanderling	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No
SPA Article 4.2: Shoveler	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx	No

[45] https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/helping-species/curlew/

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	For wintering, the Eurasian wigeon is associated with the broad habitat type "standing open water and canals"; air pollution impacts from NOx are not expected to be significant on broad habitats comprised primarily of open water.	
SPA Article 4.2: Teal	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is "no expected negative impact on species due to impacts on the species' broad habitat".	No
SPA Article 4.2: Turnstone	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx: APIS indicates there is "no expected negative impact on species due to impacts on the species' broad habitat."	No
SPA Article 4.2: Wigeon	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx For wintering, the Eurasian wigeon is associated with the broad habitat types "standing open water and canals" and "littoral sediment". Most of the area predicted to exceed a total NOx concentration of 30 µg/m^3 in 2023 is comprised of intertidal mudflat and seagrass beds; these would be regularly inundated with tidal waters and air pollution impacts are not expected to be significant. There are also small areas of habitat types which are not regularly inundated, including saltmarsh, woodland, lowland meadow, grazing marsh and scrub. Given the relatively small areas of these habitats which are predicted to experience NOx concentrations >30 µg/m^3 in 2023, compared to the wealth of larger areas of similar habitats located elsewhere within the designated site, it is not anticipated that NOx concentrations >30 µg/m^3 in the narrow bands either side of the A27 will have an adverse effect on the bird species for which this site is designated. As such, the Fareham 2023 DM development scenario is considered to have no adverse effects.	No
SPA Article 4.2: Waterbird Assemblage: Bar-tailed godwit, curlew, dark-bellied Brent geese, dunlin, grey plover, pintail,	All of these birds are considered individually above.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
red-breasted merganser, redshank, ringed plover, sanderling, shelduck, shoveler, teal, turnstone and wigeon		

3.1.4.6 Assessment summary and conclusions

Adverse effects (pre-mitigation) can be discounted for all qualifying features of the Chichester and Langstone Harbours Ramsar and SPA, and for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

On the basis of available evidence, adverse effects on this Ramsar and SPA site can be discounted and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

3.1.4.7 Recommendations

The available evidence includes consideration of forecast NOx background maps, which contain a degree of uncertainty. It is recommended that Fareham maintain a watching brief on the Defra forecasts of future trends in airborne NOx. If it appears likely that the expected reductions in NOx will not be achieved, Fareham should review this assessment in the light of the updated forecasts and taking into account any other new data, in order to determine whether additional mitigation may be required. It is recommended that a formal review will take place at least once every three years. It would be appropriate for this formal review to take place as part of the programme for wider-ranging review of the Fareham Borough Local Plan HRA.

3.2 New Forest Ramsar (UK11047) and SPA (UK9011031)

3.2.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Lymington River SSSI, Norely Copse and Meadow SSSI, River Avon System SSSI, The New Forest SSSI

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 1: Valley mires and wet heaths are found throughout the site and are of outstanding scientific interest. The mires and heaths are within catchments whose uncultivated and undeveloped state buffer the mires against adverse ecological change. This is the largest concentration of intact valley mires of their type in Britain.

Ramsar Criterion 2: The site supports a diverse assemblage of wetland plants and animals including several nationally rare species. Seven species of nationally rare plants are found on the site, as are at least 65 British Red Data Book species of invertebrate. The higher plants *Cicendia filiformis*, *Illecebrum verticillatum* and *Myosurus minimus* are considered vulnerable by the GB Red Book; while *Mentha pulegium* and *Ranunculus tripartitus* are included as endangered; and *Pulicaria vulgaris* as critically endangered. The Dark Guest Ant *Anergates atratulus* is also considered vulnerable by the IUCN Red List.

Ramsar Criterion 3: The mire habitats are of high ecological quality and diversity and have undisturbed transition zones. The invertebrate fauna of the site is important due to the concentration of rare and scarce wetland species. The whole site complex, with its examples of semi-natural habitats is essential to the genetic and ecological diversity of southern England. The site contains a rich invertebrate fauna.

3.2.2 SPA background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Lymington River SSSI, Norely Copse and Meadow SSSI, River Avon System SSSI, The New Forest SSSI

The site qualifies under **Article 4.1** of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season:	
Dartford Warbler *Sylvia undata*	538 pairs representing at least 33.6% of the breeding population in Great Britain (1993)
Honey Buzzard *Pernis apivorus*	2 pairs representing at least 10.0% of the breeding population in Great Britain (1993)
Nightjar *Caprimulgus europaeus*	300 pairs representing at least 8.8% of the breeding population in Great Britain (1993)
Woodlark *Lullula arborea*	184 pairs representing at least 12.3% of the breeding population in Great Britain (1997)
Hobby *Falco subbuteo*	N/A
Wood warbler *Phylloscopus sibilatri*	N/A
During the non-breeding season:	
Hen Harrier *Circus cyaneus*	15 individuals representing at least 2.0% of the wintering population in Great Britain (1993)

The Site Improvement Plan (SIP141124) states that nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,
- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.2.3 HRA Stage 1: Assessment of air quality impacts against screening thresholds

Table 3-5 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-5 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for The New Forest Ramsar & SPA

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Caprimugulus europaeus - European nightjar	**5**	**0.862**	**3**
Lulla arborea - Wood lark	**5**	**0.862**	**3**
Pernis apivorus - European honey-buzzard	10	1.062	**3**
Circus cyaneus - Hen harrier	10	**0.862**	**3**
Falco subbuteo - Eurasian hobby	10	**0.862**	**3**
Sylvia undata - Dartford warbler	10	**0.862**	**3**
Phylloscopus sibilatrix - Wood warbler	10	1.062	**3**

Consideration of in-combination effects

The original PfSH study area contained portions of the New Forest Ramsar and SPA. Supplementary traffic data was incorporated into the model (see Section 2.3.4) in order to ensure that in-combination development and increased traffic along the most important road links crossing the entirety of the New Forest designated sites were included in this study. The PfSH model was then used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-6 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the M27).

All four pollutants exceeded the 1% screening threshold for the Fareham 2023 DM scenario, and therefore likely significant effects from air quality impacts cannot be ruled-out for any pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-6 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Forest	5	4.29	85.7%
	Grassland	5	2.60	52.0%
Acid deposition (kEq/ha-year)	Forest	0.862	0.31	35.4%
	Grassland	0.862	0.19	21.5%
Airborne NOx (µg/m^3)	n/a	30	12.8	42.8%
Airborne NH_3 (µg/m^3)	n/a	3	0.35	11.7%

The site is a mixture of areas with tall and short vegetation; both grassland and forest deposition rates apply, to different areas.

3.2.4 HRA Stage 2: Appropriate Assessment

3.2.4.1 Nitrogen deposition

Figure 3-8 illustrates the areas where the modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.05 kgN/ha-year (1% of the lowest CL).

According to APIS, the current background levels at The New Forest Ramsar and SPA site for nitrogen deposition range from 11.1 to 16.9 kgN/ha-year in areas with short vegetation[46], where grassland deposition rates are assumed. In areas of tall vegetation[47], where forest deposition rates are assumed, background levels range from 17.4 to 27.6 kgN/ha-year.

Table 3-7 summarizes the sensitive features in the New Forest site along with their applicable CLs, and considers these in the context of existing background concentrations to determine whether adverse effects for each feature can be discounted at this stage of the analysis.

[46] Site/Feature Information, The New Forest, assuming grassland deposition rates, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK9011031&deptype=M&featurecode=A224&accode=CA, accessed 16/08/2019

[47] Site/Feature Information, The New Forest, assuming forest deposition rates, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK9011031&deptype=F&featurecode=A224&accode=UMW, accessed 16/08/2019

Figure 3-8 Overview of screening results for nitrogen deposition at The New Forest Ramsar & SPA, assuming a CL of 5 kgN/ha-year

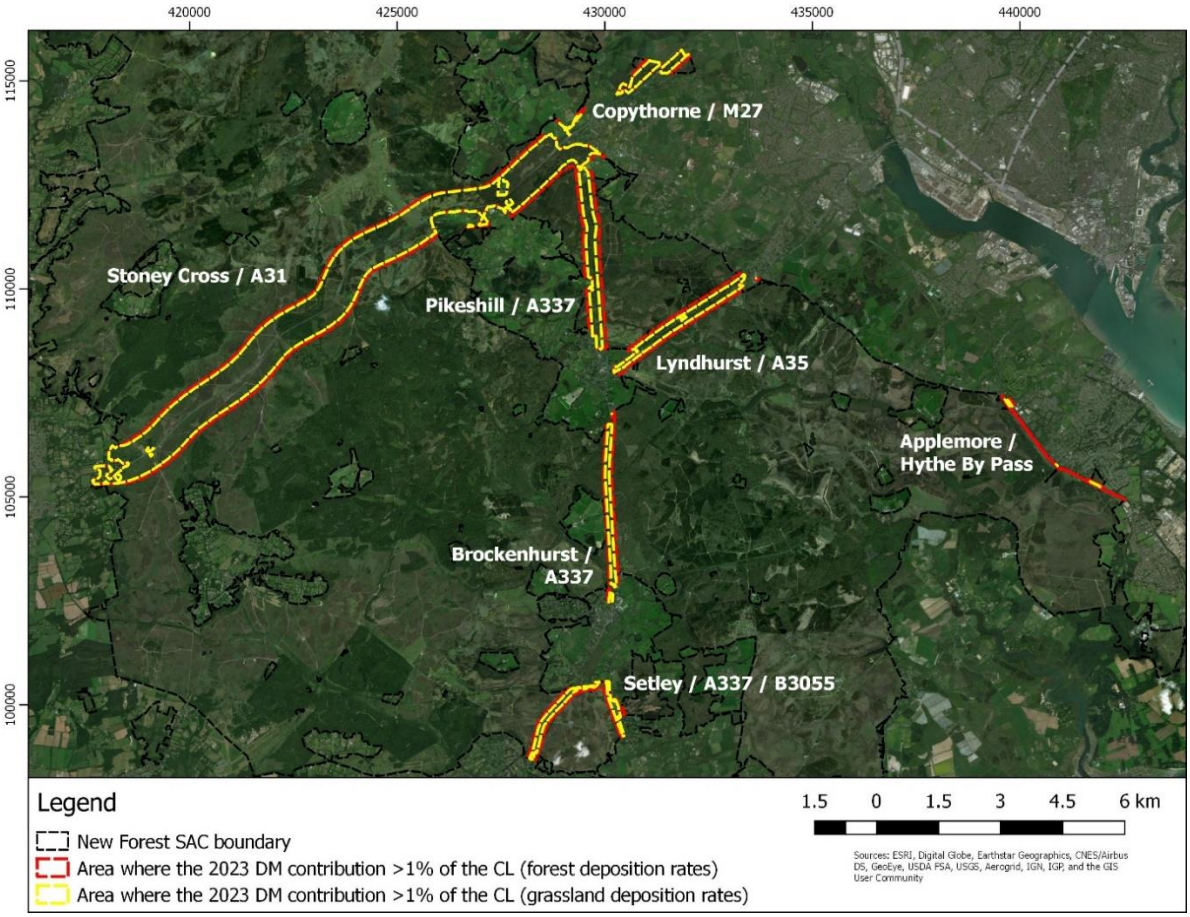


Table 3-7 Summary of relevant Critical Loads (CLs) and consideration of existing background levels of nitrogen deposition for sensitive features within The New Forest Ramsar & SPA

CL range (kgN/ha-year)	Sensitive feature	Comments
5 to 15	*Caprimulgus europaeus* - European nightjar (for reproducing in coniferous woodland)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.
	Lullula arborea - Wood lark (for reproducing in coniferous woodland)	Forest deposition rates apply, and the background nitrogen deposition levels range from 17.4 to 27.6 kgN/ha-year, which already exceeds the higher end of the CL range. If this feature is present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
10 to 20	*Caprimulgus europaeus* - European nightjar (for reproducing in dwarf shrub heath)	APIS specifies “Use the high end of the range with high precipitation and the low end of the range with low precipitation; Use the low end of the range for systems with a low water table, and the high end of the range for systems with a high water table. Note that water table can be modified by management; Use the high end of

CL range (kgN/ha-year)	Sensitive feature	Comments
	Lullula arborea - Wood lark (for reproducing in dwarf shrub heath)	the range when sod cutting has been practiced; use the lower end of the range with low intensity management." Grassland deposition rates apply, and the background nitrogen deposition levels range from 11.1 to 16.9 kgN/ha-year. In a worst-case scenario, with the maximum modelled contribution occurring with the maximum background concentration, the total predicted level of nitrogen deposition is 19.5 kgN/ha-year, which is just slightly below the upper end of the CL. If these features are present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas, the model predications at those areas, precipitation levels, water table and site management.
	Sylvia undata - Dartford warbler (for reproducing in dwarf shrub heath)	
	Pernis apivorus - European honey-buzzard (for reproducing in broadleaved, mixed and yew woodland)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.
	Circus cyaneus - Hen harrier (for wintering in dwarf shrub heath)	
	Falco subbuteo - Eurasian hobby (for reproducing in dwarf shrub heath)	
	Falco subbuteo - Eurasian hobby (for reproducing in broadleaved, mixed and yew woodland)	
	Phylloscopus sibilatrix - *Wood warbler* (for reproducing in broadleaved, mixed and yew woodland)	
15 to 30	*Circus cyaneus* - Hen harrier (for wintering in fen, marsh and swamp)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.
20 to 30	*Circus cyaneus* - Hen harrier (for wintering in fen, marsh and swamp)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.

Based on the analysis in Table 3-7, sensitive features for which the CL range for nitrogen deposition is *entirely* exceeded in the areas affected by road traffic emissions include:

- *Lullula arborea* - Wood lark (for reproducing in coniferous woodland)

Similarly, sensitive features for which the CL range for nitrogen deposition is *partially* exceeded in the areas affected by road traffic include:

- *Caprimulgus europaeus* - European nightjar (for reproducing in dwarf shrub heath)
- *Lullula arborea* - Wood lark (for reproducing in dwarf shrub heath)
- *Sylvia undata* - Dartford warbler (for reproducing in dwarf shrub heath)

On the basis of the available evidence, including dispersion modelling results and background nitrogen deposition rates, adverse effects (pre-mitigation) from nitrogen deposition cannot be ruled out for these species: European nightjar (*Caprimulgus europaeus*), Wood lark (Lullula arborea) and Dartford Warbler (*Sylvia undata*).

3.2.4.2 Acid deposition

APIS specifies that although the heath and woodland broad habitats within this site are sensitive to acidity, none of the bird species listed for this Ramsar and SPA site are sensitive due to acidity impacts on their broad habitat. Acidity impacts on the underlying broad habitat species are considered in greater depth in the section on The New Forest SAC (section 3.3).

On the basis of available evidence, including the qualifying bird species not being sensitive to acid deposition effects on the species' broad habitats, there are no adverse effects on this Ramsar and SPA site arising from increased acid deposition associated with either the Fareham 2023 DM development scenario.

3.2.4.3 Airborne NOx

The relevant CL for the New Forest Ramsar and SPA is 30 µg/m^3 for all vegetation.

In Figure 3-9, the purple areas (Fareham short-term development contribution) correspond to areas predicted to exceed the NOx screening threshold (1% of 30 µg/m^3). The red areas correspond to areas predicted to exceed the total CL for NOx in 2023.

The areas predicted to continue to exceed the critical level in 2023 are adjacent to the M27 and A31, and extend up to approximately 50m from the road edge. This comprises a significantly smaller area of impact than what has already been considered for nitrogen deposition and acid deposition.

Information on APIS indicates that although their broad habitat type is sensitive to impacts from airborne NOx, there is "no expected negative impact on species due to impacts on the species' broad habitat" for the following species:

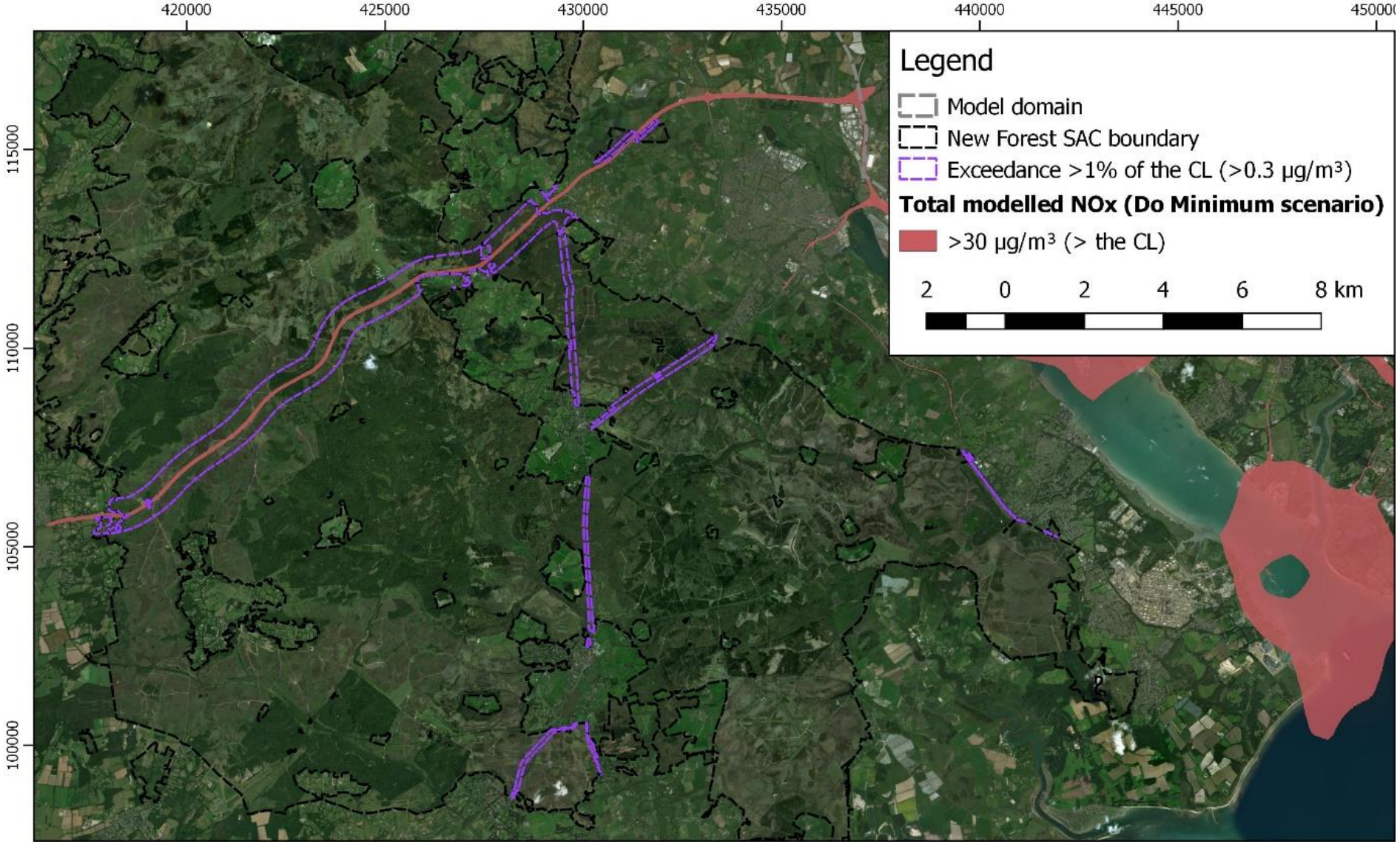
- *Pernis apivorus* - European honey-buzzard
- *Circus cyaneus* - Hen harrier
- *Falco subbuteo* - Eurasian hobby
- *Phylloscopus sibilatrix* - Wood warbler

Information on APIS indicates that there is "potential negative impact on species due to impacts on the species' broad habitats" for the following species:

- *Caprimulgus europaeus* - European nightjar (for reproducing in dwarf shrub heath)
- *Lullula arborea* - Wood lark (for reproducing in dwarf shrub heath and in coniferous woodland)
- *Sylvia undata* - Dartford warbler (for reproducing in dwarf shrub heath)

On the basis of the available evidence, including dispersion modelling results and forecast NOx background rates, adverse effects (pre-mitigation) from airborne NOx cannot be ruled out for these species: European nightjar (*Caprimulgus europaeus*), Wood lark (*Lullula arborea*) and Dartford Warbler (*Sylvia undata*).

Figure 3-9 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at The New Forest Ramsar & SPA



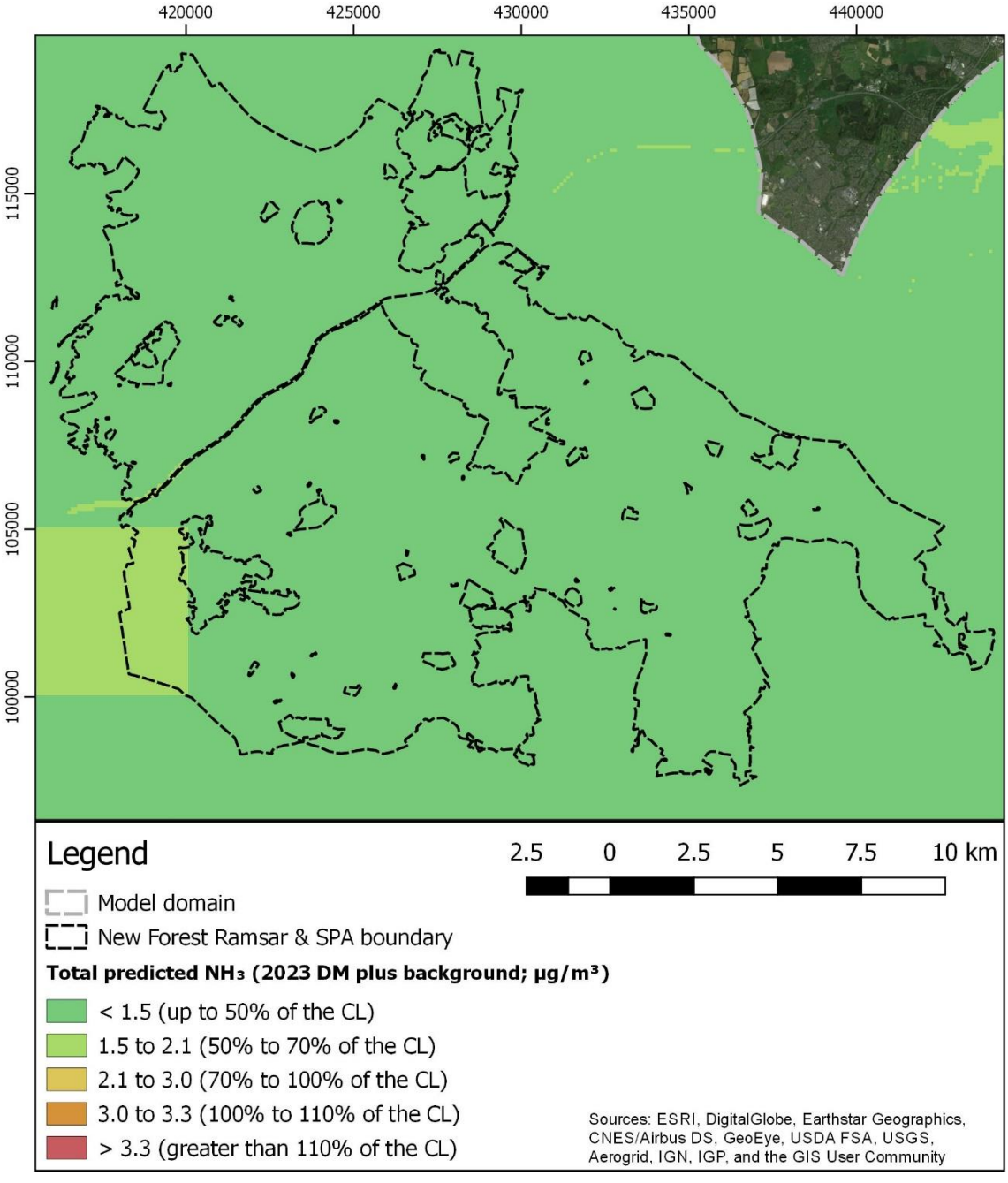
3.2.4.4 Airborne NH_3

The relevant CL for The New Forest Ramsar and SPA is 3 µg/m^3 for all features.

The DM contribution of airborne NH_3 was added to background levels of ammonia across the site[46,47]. The maximum total concentration of NH_3 measured by zonal statistics was 1.76 µg/m^3, 58.7% of the CL.

On the basis of available evidence, including the current background levels of ammonia, there are no adverse effects on this Ramsar and SPA site arising from increased ammonia associated with the Fareham 2023 DM development scenario.

Figure 3-10 Total modelled concentrations of airborne ammonia at The New Forest Ramsar & SPA in 2023, assuming a CL of 3 µg/m^3



3.2.4.5 Previous work on The New Forest Ramsar and SPA

This section provides an overview of previous work that has been undertaken on the New Forest designated sites (SAC, Ramsar and SPA).

Air Quality Consultants Ltd. carried out an air quality study in 2018[48] as part of the evidence base for the New Forest and New Forest National Park Authority Local Plans. In order to address in-combination impacts, the study compared the results of a model using 2015 traffic flows and future emission factors against each of the 2026 and 2036 Do-Something scenarios. This approach would therefore include traffic impacts associated with development in nearby local authorities, including a contribution from Fareham. This report concluded that, based on the modelling results, additional ecological analysis was required as part of the HRA process.

BSG Ecology carried out the ecological analysis.[49] The assessment focused on air quality impacts on the SAC habitats as SAC features are typically more vulnerable to impacts arising from airborne pollutants; it is likely that effects on faunal species will be indirect and result from changes to the habitats on which the faunal species rely. Based on a comparison of the predicted areas of exceedance in the current study for Fareham, as compared to the areas of exceedance predicted for the New Forest HRA studies (see Table 5 of the report by BSG Ecology), the areas of exceedance predicted in the current study are generally considerably smaller than those considered for the New Forest HRAs. For example, the current study predicts worst-case nitrogen deposition exceedances of the screening threshold to extend up to approximately 800m from the A31, whereas Table 5 of the BSG report indicates exceedances up to 2,560m from the A31 in the 2036 in-combination scenario. The BSG report indicates that there is some uncertainty in the mapping datasets used to determine habitat distribution, noting that "*it is understood that the SAC habitats have been mapped using aerial imagery to define their extent; however, it is not known what 'ground-truthing' has taken place*". The report by BSG Ecology concluded that: "*Overall it is considered that implementation of the New Forest District Council Local Plan and the New Forest National Park Authority Local Plan is not likely to have an adverse effect on the integrity of the New Forest SAC, SPA and Ramsar sites when considered in isolation. In combination effects will result in exceedances for ammonia and acid deposition, although exceedance of critical loads / levels is predicted in the absence of the Local Plans.*"

In summarising the recommendations of the ecological assessment, the HRA document for the NFDC local plan[50] contains the following text, and similar text appears in the HRA document for the NFNPA local plan[51]: *"the ecological assessment recommends that NFDC and NFNPA undertake periodic vegetation monitoring to determine the current condition of sensitive vegetation and to identify any changes that occur during the life of the two Local Plans (measured at appropriate intervals). Screening and habitat enhancement/management measures that can be used to mitigate the impact of airborne pollutants are also summarised in the ecological assessment. Further to these recommendations, Natural England is coordinating further monitoring to address the uncertainty, as described in more detail in the 'Existing mitigation'".* The two local plan HRA documents identified the need for more information on the effects of air pollution on The New Forest SAC, SPA and Ramsar sites.

Ecological Planning & Research Ltd (EPR) was commissioned to assist New Forest District Council (NFDC) and the New Forest National Park Authority (NFNPA) with aspects of their Local Plan HRAs,

[48] Air Quality Consultants (AQC), "Air Quality Input for Habitats Regulations Assessment: New Forest", April 2018.

[49] BSG Ecology, "New Forest District Council and New Forest National Park Authority: Ecological Consultancy Advice on Air Quality Risks", May 2018.

[50] LUC, "Habitats Regulations Assessment of New Forest District Local Plan Part 1: Assessment of Cabinet draft of Proposed Submission Plan", May 2018.

[51] LUC, "Habitats Regulations Assessment of New Forest Park Local Plan 2016-2036: Assessment of Regulation 19 Submission Draft", January 2018.

to address information deficits including obtaining primary field data, to propose a monitoring framework and to consider mitigation options[52].

There are three main recommendations from the Air Quality Ecological Mitigation Plan report:

1. Address existing information deficits. The Hampshire Biodiversity Information Centre (HBIC) Broad Habitats Data (and information from other sources) is not currently considered of sufficiently high resolution to be able to identify the location and distribution of Annex 1 habitats, which have a high degree of variability in the New Forest. Therefore, the recommendation was to complete detailed NVC baseline mapping of seven locations of interest, of about 10ha each. Lichen mapping would be included in this baseline.

2. Establish a monitoring framework – this would essentially act as an early warning system for the effects of air pollution on the features of the designated sites. The vegetation monitoring should include:
    a. Monitoring the extent of heathland within the New Forest SAC (aerial mapping);
    b. Surveying the structure and composition of the heathland by sampling within quadrats along transects; and
    c. Investigating the nitrogen and amino acid concentrations in soil and vegetation using samples taken in quadrats along transects.

    For each quadrat sampled, the cover and abundance of lichen species, heather to grass ratio, and a measure of heather damage should be collected. Samples should also be taken of soil and foliar material to test for key soil nutrients including soil nitrogen and phosphorus. The lichen monitoring method designed by Wolseley and further developed by APIS[53] should be employed.

3. Develop a set of mitigation measure to be implemented if the results of monitoring show adverse effects on the designated sites' features. Table 7.2 of the EPR report provides a costed summary of potential management techniques for reducing nitrogen from SAC qualifying habitats, and many of these would build on the management techniques already employed in the New Forest. Options proposed included: shelterbelting areas, habitats management (the current processes which are outlined in the New Forest SSSI information documents), and nitrogen recovery strategies adapted from those already developed in the Netherlands. Transport-related mitigation measures were identified as a need, for example reducing traffic flows, improving traffic efficiency, encouraging walking/cycling and encouraging use of low emission vehicles. However, EPR concluded that the mitigation measures fell outside their professional competence as an ecological consultancy and recommended the Councils secure advice from transport experts in undertaking their implementation, if the monitoring strategy indicates that implementation is required.

The EPR report concluded that the fieldwork and desktop review "*have not yielded any evidence to indicate that New Forest habitats are currently experiencing negative effects from traffic related air pollution*", and that the analysis undertaken for the report "*did not reveal anything to suggest that present levels of traffic-related air pollution are the underlying cause for any observable patterns or observations in vegetation that could be linked to an adverse effect on the integrity of the SAC habitats.*" However, it was noted that work carried out by AQC[48] indicates that "*that there will be increases in traffic-related nitrogen pollution on roads across the New Forest, some of which will be in exceedance of the relevant CLs, and toward which the Local Plans will contribute more than 1% of the CL.*" The monitoring strategy and mitigation options outlined in the report were designed to provide a means of early identification and mitigation of possible adverse effects associated with the Local Plans.

[52] Ecological Planning & Research Ltd. (EPR), "New Forest Air Quality Ecological Mitigation Plan", August 2018.

[53] http://www.apis.ac.uk/nitrogen-lichen-field-manual

3.2.4.6 Assessment summary

This study identified potential adverse effects (pre-mitigation) at the New Forest Ramsar and SPA for the following qualifying features:

- *Caprimulgus europaeus* - European nightjar (nitrogen deposition and airborne NOx)
- *Lullula arborea* - Wood lark (nitrogen deposition and airborne NOx)
- *Sylvia undata* - Dartford warbler (nitrogen deposition and airborne NOx)

Adverse effects can be discounted for all other qualifying features of the Ramsar and SPA, as well as for acid deposition and NH_3 as causal pollutants.

There remains some uncertainty in the evidence base for the New Forest designated sites, including with regards to:

- The existing background concentrations of pollutants; the current analysis is based on 1km x 1km modelled values for NOx concentrations, and 5km x 5km modelled values for NH_3 concentrations as well as nitrogen and acid deposition rates)
- The location of sensitive features within the larger designated sites, as highlighted by the recommendation from EPR[52] to complete detailed baseline NVC and lichen mapping of seven locations of interest.

3.2.4.7 Mitigation

The existing HRA evidence base for the New Forest designated sites (section 3.2.4.5) shows there is already a system in place to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest Ramsar and SPA. In the short-term we can conclude no adverse effects arising from for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

The results of this study consider the effects of short-term development (up to 2023) within Fareham, in-combination with development in the other PfSH local authorities. Similarly, the work undertaken previously for the NFDC and NFNPA Local Plans considers a scenario for 2026 development levels, with the New Forest local plans in combination with other development in the region.

The individual contribution from development within Fareham, to the effects on any of the designated sites within this study, has not been quantified due to a lack of suitable transport modelling datasets. Fareham's individual contribution can be calculated based on the upcoming modelling work for the Fareham Local Plan HRA. However, it is likely that the majority of the effects on the New Forest designated sites can be attributed to development located closer to the designated sites, i.e. development within New Forest, Southampton, etc. The individual contribution from Fareham is likely to be relatively small. Likewise, the ability of Fareham Borough Council to contribute to i.e. traffic-related mitigation measures for New Forest sites is also small.

3.2.4.8 Conclusions

With the application of the mitigation and monitoring strategy advocated above (Section 3.2.4.7) and in previous work undertaken for the New Forest designated sites (section 3.2.4.5), adverse effects on the qualifying features of the New Forest Ramsar and SPA can be prevented and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development considered in the Fareham 2023 DM scenario.

Natural England has confirmed[40] that provided the New Forest designated sites are included in the HRA analysis for the Fareham Local Plan HRA, and that this includes further discussions with New Forest District Council and analysis of the monitoring programme, no further comments are raised regarding the above approach.

3.3 New Forest SAC (UK0012557)

3.3.1 SAC background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Landford Bog SSSI, Langley Wood and Homan's Copse SSSI, Loosehanger Copse and Meadows SSSI, Roydon Woods SSSI, The New Forest SSSI, Whiteparish Common SSSI

Qualifying and notifiable features associated with this site comprise: H3110 Oligotrophic water contains few minerals of sandy plains, H3130 Oligotrophic to mesotrophic standing water with vegetation, H3260 Water courses of plain to montane levels with *R. fluitantis*, H4010 Northern Atlantic wet heaths with *Erica tetralix*, H4020 Temp Atlantic wet heaths with *Erica ciliaris* and *E. tetralix*, H4030 European dry heaths, H6410 Molinia meadows on calcareous, peat or clay-silt soil, H7140 Transition mires and quaking bogs, H7150 Depressions on peat substrates of the *Rhynchosporion*, H7230 Alkaline fens, H9120 Atlantic acidophilous beech forests with Ilex, H9130 *Asperulo-Fagetum* beech forests, H9190 Old acidophilous oak woods with Q. robur on sandy plains, H91D0 Bog woodland, H91E0 Alluvial woods with *A. glutinosa*, *F. excelsior*, S1044 Southern damselfly, *Coenagrion mercurial*, S1083 Stag beetle *Lucanus cervus*, S1166 Great crested newt, *Triturus cristatus*.

The Site Improvement Plan (SIP141124) discussed in Section 3.2.2 covers both SPA and SAC. Nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

3.3.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-1 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-8 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for The New Forest SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea	**3**	No CL found on APIS	Site specific advice should be sought

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs ($\mu g/m^3$)
Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	5	No CL found on APIS	Site specific advice should be sought
Bog woodland	5	**0.547**	Site specific advice should be sought
Transition mires and quaking bogs	10	**0.547**	**1**
Depressions on peat substrates of the *Rhynchosporion*	10	**0.547**	**1**
Old acidophilous oak woods with *Quercus robur* on sandy plains	10	1.062	Site specific advice should be sought
Northern Atlantic wet heaths with *Erica tetralix*	10	0.862	**1**
European dry heaths	10	0.862	**1**
Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*)	10	1.062	Site specific advice should be sought
Asperulo-Fagetum beech forests	10	1.062	Site specific advice should be sought
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	15	0.586	Site specific advice should be sought
Alkaline fens	15	Not sensitive	**1**
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)	Not sensitive	Not sensitive	**1**
Coenagrion mercuriale - Southern damselfly	10	0.862	3
Lucanus cervus - Stag beetle	10	1.062	3
Triturus cristatus - Great crested newt	Site specific advice should be sought	No CL found on APIS	3

Consideration of in-combination effects

The original PfSH study area contained portions of the New Forest Ramsar and SPA. Supplementary traffic data was incorporated into the model (see Section 2.3.4) in order to ensure that in-combination development and increased traffic along the most important road links crossing the entirety of the New Forest designated sites were included in this study. The PfSH model was then used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described

in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-9 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the M27).

All four pollutants exceeded the 1% screening threshold for the Fareham 2023 DM scenario, and therefore likely significant effects from air quality impacts cannot be ruled-out for any pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-9 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Forest	5*	5.08	101.5%
	Grassland	5*	3.12	62.5%
Acid deposition (kEq/ha-year)	Forest	0.547	0.36	66.1%
	Grassland	0.547	0.22	40.7%
Airborne NOx (µg/m^3)	n/a	30	19.0	63.2%
Airborne NH_3 (µg/m^3)	n/a	1	0.45	45.1%

*A CL of 5 has been used for screening purposes. A CL range of 3 to 10 applies to some features (Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*), however APIS specifies that this critical load "should only be applied to "oligotrophic waters with low alkalinity with no significant agricultural or other human inputs." This would not be the case for any oligotrophic waters located in the areas predicted to exceed the screening threshold, as they would already have significant inputs from human activity (road traffic).

The site is a mixture of areas with tall and short vegetation; both grassland and forest deposition rates apply, to different areas.

3.3.3 HRA Stage 2: Appropriate Assessment

3.3.3.1 Nitrogen deposition

Areas predicted to exceed the 1% screening threshold for nitrogen deposition are the same as those discussed for the Ramsar and SPA. The features will be discussed separately, as different features are included in the SAC as compared to the Ramsar and SPA.

Figure 3-11 illustrates the areas where the modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.05 kgN/ha-year (1% of the lowest applicable CL).

Table 3-10 summarizes the sensitive features in the New Forest site along with their applicable CLs, and considers these in the context of existing background concentrations to determine whether adverse effects for each feature can be discounted at this stage of the analysis.

According to APIS, the current background levels at The New Forest SAC site for nitrogen deposition range from 9.8 to 27.6 kgN/ha-year[54,55].

Figure 3-11 Overview of screening results for nitrogen deposition at The New Forest SAC, assuming a CL of 5 kgN/ha-year

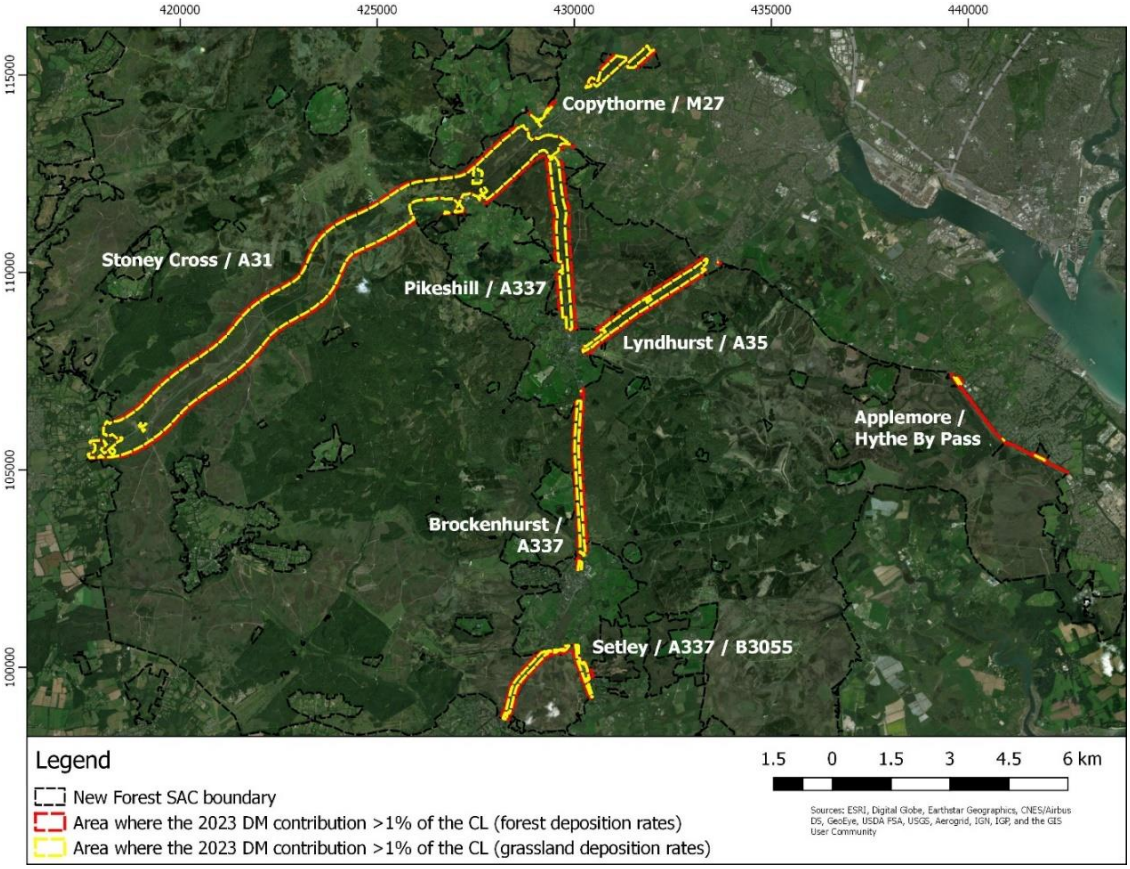


Table 3-10 Summary of relevant Critical Loads (CLs) and consideration of existing background levels of nitrogen deposition for sensitive features within the New Forest SAC

CL range (kgN/ha-year)	Sensitive feature	Comments
3 to 10	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*.	APIS indicates that "the critical load should only be applied to oligotrophic waters with low alkalinity with no significant agricultural or other human inputs." This would not be the case for any oligotrophic waters located in the areas predicted to exceed the screening threshold, as they would already have significant inputs from human activity (road traffic). Adverse effects are not anticipated based on where the CL should be applied.
5 to 10	Oligotrophic waters containing very few minerals of sandy plains	APIS indicates that "the critical load should only be applied to oligotrophic waters with low alkalinity with no significant agricultural or other human inputs." This

[54] Site/Feature Information, The New Forest, assuming grassland deposition rates, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK0012557&deptype=G&featurecode=H3130&accode=FW, accessed 16/08/2019.

[55] Site/Feature Information, The New Forest, assuming forest deposition rates, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK0012557&deptype=F&featurecode=H91D0&accode=BO, accessed 16/08/2019.

CL range (kgN/ha-year)	Sensitive feature	Comments
		would not be the case for any oligotrophic waters located in the areas predicted to exceed the screening threshold, as they would already have significant inputs from human activity (road traffic). Adverse effects are not anticipated based on where the CL should be applied.
	Bog woodland	APIS specifies "seek site specific advice for site value. Use the high end of the range with high precipitation and the low end of the range with low precipitation; Use the low end of the range for systems with a low water table, and the high end of the range for systems with a high water table." Forest deposition rates apply, and the background nitrogen deposition levels range from 16.9 to 27.6 kgN/ha-year, which already exceeds the higher end of the CL range. If this feature is present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
10 to 15	Transition mires and quaking bogs	APIS specifies "for D2.1 (quaking fens and transition mires): use lower end of the range." Grassland deposition rates apply, and the background nitrogen deposition levels range from 10.6 to 17.2 kgN/ha-year. The lower end of the CL is already exceeded, and in many places within the SAC, the higher end of the CL is exceeded as well. If these features are present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
	Depressions on peat substrates of the *Rhynchosporion*	
	Old acidophilous oak woods with *Quercus robur* on sandy plains	Forest deposition rates apply, and the background nitrogen deposition levels range from 16.9 to 27.6 kgN/ha-year, which already exceeds the higher end of the CL range. If this feature is present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
10 to 20	Northern Atlantic wet heaths with *Erica tetralix*	APIS specifies "Use the high end of the range with high precipitation and the low end of the range with low precipitation; Use the low end of the range for systems with a low water table, and the high end of the range for systems with a high water table. Note that water table can be modified by management; Use the high end of the range when sod cutting has been practiced; use the lower end of the range with low intensity management."
	European dry heaths	

CL range (kgN/ha-year)	Sensitive feature	Comments
	Coenagrion mercuriale - Southern damselfly (in the Northern wet heaths habitat)	Grassland deposition rates apply, and the background nitrogen deposition levels range from 10.6 to 17.2 kgN/ha-year. The lower end of the CL is already exceeded throughout the SAC. In a worst-case scenario, with the maximum modelled contribution occurring with the maximum background concentration, the total predicted level of nitrogen deposition is 20.32, which is just slightly above the upper end of the CL. If these features are present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas, the model predications at those areas, precipitation levels, water table and site management.
	Asperulo-Fagetum beech forests Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*)	Forest deposition rates apply, and the background nitrogen deposition levels range from 16.9 to 27.6 kgN/ha-year. Nitrogen deposition from the modelled development is predicted to contribute up to a maximum of 5.08 kgN/ha-year, immediately adjacent to a road surface. If these features are present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas and the model predications at those areas.
	Lucanus cervus - Stag beetle (in the broadleaved deciduous woodland habitat)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.
15 to 25	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Grassland deposition rates apply, and the background nitrogen deposition levels range from 10.6 to 17.2 kgN/ha-year. Nitrogen deposition from the modelled development is predicted to contribute up to a maximum of 3.12 kgN/ha-year, immediately adjacent to a road surface. Accounting for the contribution from the modelled development, the lower end of the CL range is exceeded in some areas of the SAC, and the upper end of the CL range is not exceeded anywhere in the SAC. If these features are present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas and the model predications at those areas.

Based on the analysis in Table 3-10, sensitive features for which the CL range for nitrogen deposition is *entirely* exceeded in the areas affected by road traffic emissions include:

- Bog woodland
- Depressions on peat substrates of the *Rhynchosporion*
- Old acidophilous oak woods with *Quercus robur* on sandy plains
- Transition mires and quaking bogs

Similarly, sensitive features for which the CL range for nitrogen deposition is *partially* exceeded in the areas affected by road traffic include:

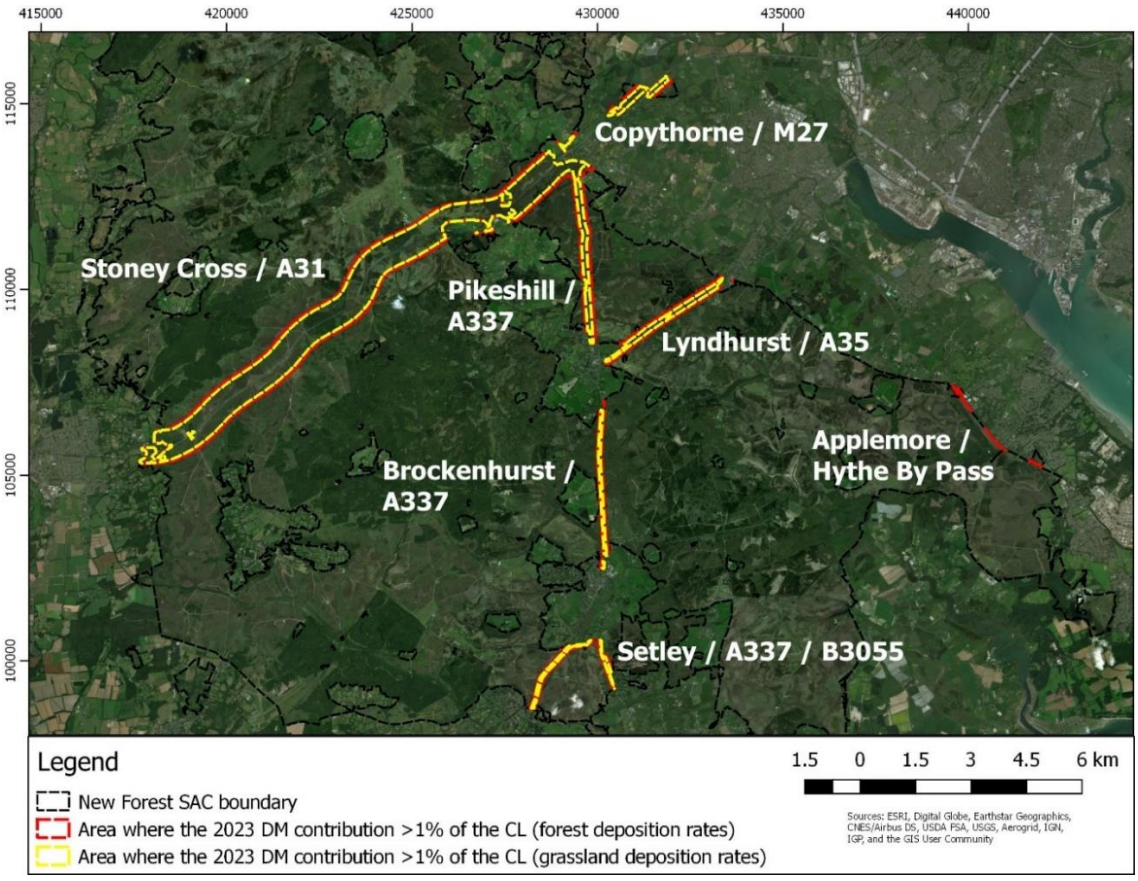
- Alkaline fens
- Asperulo-Fagetum beech forests
- Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*)
- *Coenagrion mercuriale* - Southern damselfly (in the Northern wet heaths habitat)
- European dry heaths
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- Northern Atlantic wet heaths with *Erica tetralix*

On the basis of the available evidence, including dispersion modelling results and background nitrogen deposition rates, adverse effects (pre-mitigation) from nitrogen deposition cannot be ruled out for the eleven features listed above.

3.3.3.2 Acid deposition

Figure 3-12 illustrates the areas where modelled contributions from the 2023 Fareham 2023 DM scenario are predicted to exceed 0.00547 kEq/ha-year (1% of the lowest CL).

Figure 3-12 Overview of screening results for acid deposition at The New Forest SAC, assuming a CL of 0.547 kgEq/ha-year



According to APIS, the current background levels at The New Forest SAC site for acid deposition range from 0.9 to 2.4 kEq/ha-year.[54]

Table 3-11 summarizes the sensitive features in the New Forest site along with their applicable CLs, and considers these in the context of existing background concentrations to determine whether adverse effects for each feature can be discounted at this stage of the analysis.

Table 3-11 Summary of relevant Critical Loads (CLs) and consideration of existing background levels of acid deposition for sensitive features within The New Forest SAC

CL range (kEq/ha-year)	Sensitive feature	Comments
0.547 to 0.635	Bog woodland	Forest deposition rates apply, and the background acid deposition levels range from 1.5 to 2.4 kEq/ha-year, which already exceeds the higher end of the CL range. If this feature is present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
	Transition mires and quaking bogs	Grassland deposition rates apply, and the background acid deposition levels range from 0.9 to 1.6 kEq/ha-year, which already exceeds the higher end of the CL range. If this feature is present within the areas affected by road traffic emissions, adverse effects cannot be ruled out with the available evidence.
	Depressions on peat substrates of the *Rhynchosporion*	
0.586 to 4.578	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Grassland deposition rates apply, and the background acid deposition levels range from 0.9 to 1.6 kEq/ha-year, which already exceeds the lower end of the CL range. If this feature is present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas and the model predications at those areas.
0.862 to 4.854	Northern Atlantic wet heaths with *Erica tetralix*	Grassland deposition rates apply, and the background acid deposition levels range from 0.9 to 1.6 kEq/ha-year, which already exceeds the lower end of the CL range. If this feature is present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local characteristics – the background concentrations at those areas and the model predications at those areas.
	European dry heaths	
	Coenagrion mercuriale - Southern damselfly (in the Northern wet heaths habitat)	
1.062 to 11.358	Old acidophilous oak woods with *Quercus robur* on sandy plains	Forest deposition rates apply, and the background acid deposition levels range from 1.5 to 2.4 kEq/ha-year, which already exceeds the lower end of the CL range. If this feature is present within the areas affected by road traffic emissions, they may or may not experience adverse effects from air pollution, depending on local
	Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer	

CL range (kEq/ha-year)	Sensitive feature	Comments
	(*Quercion robori-petraeae* or *Ilici-Fagenion*)	characteristics – the background concentrations at those areas and the model predications at those areas.
	Asperulo-Fagetum beech forests	
	Lucanus cervus - Stag beetle (in the broadleaved deciduous woodland habitat)	APIS specifies that the species is not sensitive due to nutrient nitrogen impacts on broad habitat. Adverse effects are not anticipated.

Based on the analysis in Table 3-11, sensitive features for which the CL range for acid deposition is *entirely* exceeded in the areas affected by road traffic emissions include:

- Bog woodland
- Depressions on peat substrates of the *Rhynchosporion*
- Transition mires and quaking bogs

Similarly, sensitive features for which the CL range for acid deposition is *partially* exceeded in the areas affected by road traffic include:

- Asperulo-Fagetum beech forests
- Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*)
- *Coenagrion mercuriale* - Southern damselfly (in the Northern wet heaths habitat)
- European dry heaths
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- Northern Atlantic wet heaths with *Erica tetralix*
- Old acidophilous oak woods with *Quercus robur* on sandy plains

On the basis of the available evidence, including dispersion modelling results and background acid deposition rates, adverse effects (pre-mitigation) from acid deposition cannot be ruled out for the ten features listed above.

3.3.3.3 Airborne NOx

The relevant CL for the New Forest SAC is 30 µg/m^3 for all vegetation.

The areas of the New Forest SAC predicted to exceed the screening threshold and the areas predicted to exceed a total NOx concentration of 30 µg/m^3 are the same areas as shown in Figure 3-9 for the Ramsar and SPA.

Information on APIS indicates that the following features are not sensitive to NOx:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (H91E0)

APIS indicates that although their broad habitat type is sensitive to impacts from airborne NOx, there is "no expected negative impact on species due to impacts on the species' broad habitat" for the following species:

- *Lucanus cervus* - Stag beetle

APIS indicates that there are potential negative impacts from NOx for the following features:

- Alkaline fens (H7230)
- *Asperulo-Fagetum* beech forests (H9130)
- Atlantic acidophilous beech forests with *Ilex* and sometimes also *Taxus* in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*) (H9120)

- Bog woodland (H91D0)
- *Coenagrion mercuriale* - Southern damselfly (for dwarf shrub heath)
- Depressions on peat substrates of the *Rhynchosporion* (H7150)
- European dry heaths (H4030)
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- Northern Atlantic wet heaths with *Erica tetralix* (H4010)
- Old acidophilous oak woods with *Quercus robur* on sandy plains
- Transition mires and quaking bogs (H7140)

On the basis of the available evidence, including dispersion modelling results and forecast background NOx concentrations, adverse effects (pre-mitigation) from NOx cannot be ruled out for the eleven features listed above.

3.3.3.4 Airborne NH_3

Airborne NH_3 considerations

The SAC contains some lichen and bryophyte species that are sensitive to NH_3, however it is difficult to determine where those features are within the SAC. It is our understanding that New Forest are currently developing more detailed mapping of the area (Section 3.2.4.5) which will address the information deficit and enable more accurate analysis in future studies.

A CL of 1 µg/m^3 is set for impacts on habitats containing sensitive lichens and/or bryophytes, such as:

- Alkaline fens
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)
- Depressions on peat substrates of the *Rhynchosporion*
- European dry heaths
- Northern Atlantic wet heaths with *Erica tetralix*
- Transition mires and quaking bogs

A higher CL of 3 µg/m^3 is set for impacts on *Coenagrion mercuriale* - Southern damselfly, *Lucanus cervus* - Stag beetle, and *Triturus cristatus* - Great crested newt; their broad habitats include Rivers and streams, Dwarf shrub heath, Broadleaved, mixed and yew woodland, and Standing open water and canals.

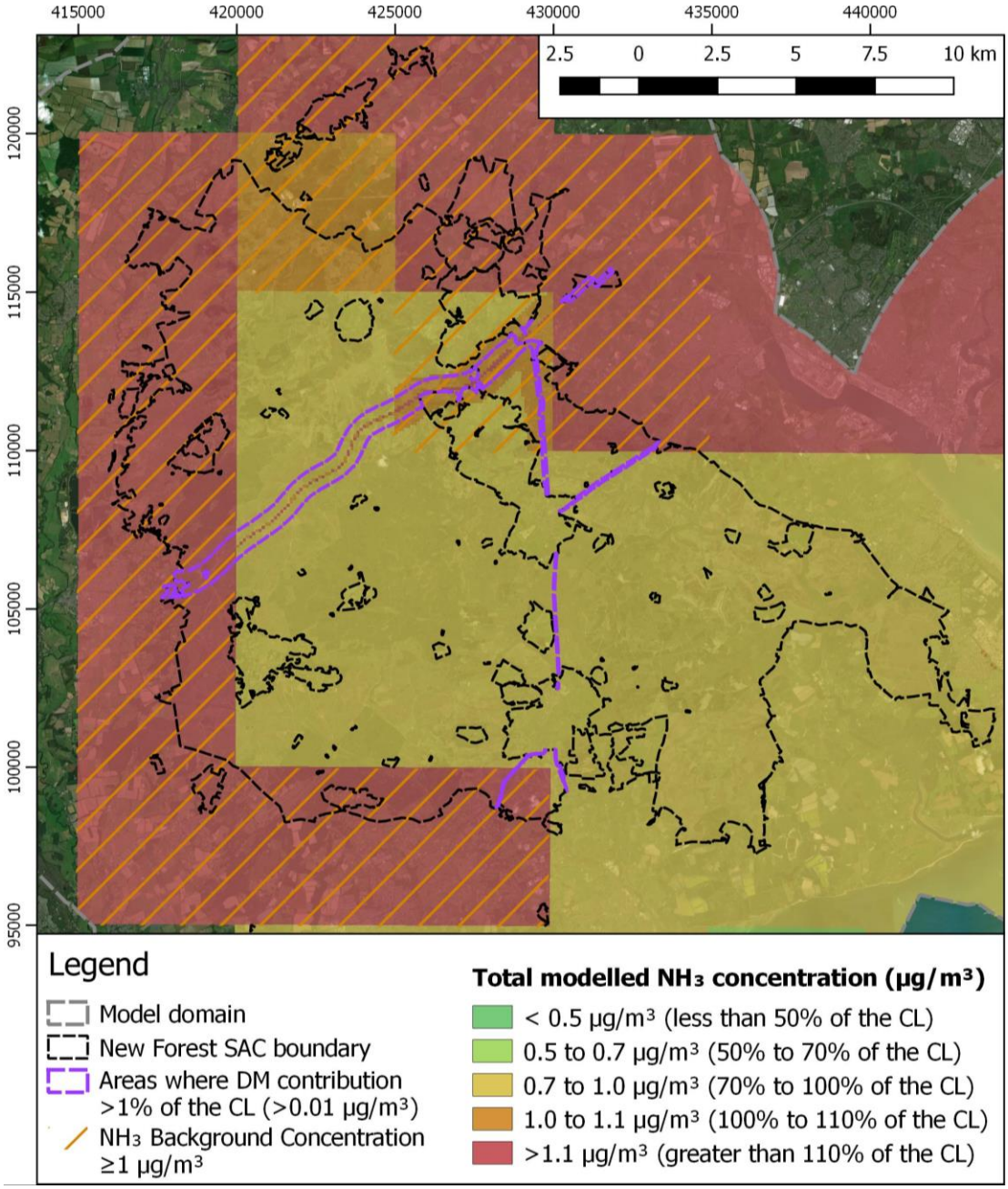
For other features, such as Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*), site specific advice should be sought.

Figure 3-13 shows the results of the Fareham 2023 DM model scenario overlaid with the 2013-2015 background NH_3 concentrations from APIS[54]. The NH_3 concentrations from APIS are on a 5 km x 5 km grid, resulting in some parts of the figure appearing pixelated.

The maximum total modelled contribution from the Fareham 2023 DM scenario was 1.72 µg/m^3, which represents 61.3% of the CL where 3 µg/m^3 is used. A likely significant effect as a result of airborne ammonia can therefore be discounted in areas where the CL of 3 µg/m^3 is applicable.

There are areas where the total concentration is predicted to exceed the CL set for sensitive lichens and bryophytes (1 µg/m^3). In some cases, this is due to the background concentration already being above the CL (where the 'grid' has been overlain with orange stripes), as is the case for an area of the map near Setley / A337 / B3055. In other cases, the background concentration is below the CL, however the additional contribution from the modelled short-term development results in the total predicted concentration exceeding the CL; this is the case along the majority of the A31.

Figure 3-13 Areas where the DM contribution of airborne NH_3 at exceeds 1% of the CL, assuming a CL of 1 µg/m³, and total modelled concentrations or airborne NH_3 at the New Forest SAC



3.3.3.5 Assessment summary

This study identified potential adverse effects (pre-mitigation) at the New Forest SAC for the following qualifying features:

- Alkaline fens (nitrogen deposition, NOx, NH_3)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (NH_3)
- Asperulo-Fagetum beech forests (nitrogen deposition, acid deposition, NOx)
- Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*) (nitrogen deposition, acid deposition, NOx)
- Bog woodland (nitrogen deposition, acid deposition, NOx)
- *Coenagrion mercuriale* - Southern damselfly (in the Northern wet heaths habitat) (nitrogen deposition, acid deposition, NOx)

- Depressions on peat substrates of the *Rhynchosporion* (nitrogen deposition, acid deposition, NOx, NH_3)
- European dry heaths (nitrogen deposition, acid deposition, NOx, NH_3)
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (nitrogen deposition, acid deposition, NOx)
- Northern Atlantic wet heaths with *Erica tetralix* (nitrogen deposition, acid deposition, NOx, NH_3)
- Old acidophilous oak woods with *Quercus robur* on sandy plains (nitrogen deposition, acid deposition, NOx)
- Transition mires and quaking bogs (nitrogen deposition, acid deposition, NOx, NH_3)

There remains some uncertainty in the evidence base for the New Forest designated sites, including with regards to:

- The existing background concentrations of pollutants; the current analysis is based on 1km x 1km modelled values for NOx concentrations, and 5km x 5km modelled values for NH_3 concentrations as well as nitrogen and acid deposition rates)
- The location of sensitive features within the larger designated sites, as highlighted by the recommendation from EPR[52] to complete detailed baseline NVC and lichen mapping of seven locations of interest.

3.3.3.6 Mitigation

The existing HRA evidence base for the New Forest designated sites (section 3.2.4.5) shows there is already a system in place to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest SAC. In the short-term we can conclude no adverse effects arising from for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

The results of this study consider the effects of short-term development (up to 2023) within Fareham, in-combination with development in the other PfSH local authorities. Similarly, the work undertaken previously for the NFDC and NFNPA Local Plans considers a scenario for 2026 development levels, with the New Forest local plans in combination with other development in the region.

The individual contribution from development within Fareham, to the effects on any of the designated sites within this study, has not been quantified due to a lack of suitable transport modelling datasets. Fareham's individual contribution can be calculated based on the upcoming modelling work for the Fareham Local Plan HRA. However, it is likely that the majority of the effects on the New Forest designated sites can be attributed to development located closer to the designated sites, i.e. development within New Forest, Southampton, etc. The individual contribution from Fareham is likely to be relatively small. Likewise, the ability of Fareham Borough Council to contribute to i.e. traffic-related mitigation measures for New Forest sites is also small.

3.3.3.7 Conclusions

With the application of the mitigation and monitoring strategy advocated above (Section 3.3.3.6) and in previous work undertaken for the New Forest designated sites (section 3.2.4.5), adverse effects on the qualifying features of the New Forest SAC can be prevented and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development considered in the Fareham 2023 DM scenario.

Natural England has confirmed[40] that provided the New Forest designated sites are included in the HRA analysis for the Fareham Local Plan HRA, and that this includes further discussions with New Forest District Council and analysis of the monitoring programme, no further comments are raised regarding the above approach.

3.4 Portsmouth Harbour Ramsar (UK11055) and SPA (UK9011051)

3.4.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Portsmouth Harbour SSSI.

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 3: The intertidal mudflat areas possess extensive beds of eelgrass *Zostera angustifolia* and *Zostera noltei* which support the grazing dark-bellied brent geese *Branta bernicla bernicla* populations. The mud-snail *Hydrobia ulvae* is found at extremely high densities, which helps to support the wading bird interest of the site. Common cord-grass *Spartina anglica* dominates large areas of the saltmarsh and there are also extensive areas of green algae *Enteromorpha* spp. and sea lettuce *Ulva lactuca*. More locally the saltmarsh is dominated by sea purslane *Halimione portulacoides* which gradates to more varied communities at the higher shore levels. The site also includes a number of saline lagoons hosting nationally important species.

Ramsar Criterion 6: Species/populations occurring at levels of international importance

Qualifying Species/populations (as identified at designation): Species with peak counts in winter:	
Dark-bellied brent goose, *Branta bernicla bernicla*	2105 individuals, representing an average of 2.1% of the GB population (5 year peak mean 1998/9-2002/3)

The Site Improvement Plan for the overlapping SPA (Solent SIP043) states that nitrogen deposition has been identified as a pressure. Ramsar sites do not have Site Improvement Plans.

3.4.2 SPA background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Portsmouth Harbour SSSI.

The site qualifies under **Article 4.2** of the Directive (79/409/EEC) by supporting populations of European importance of the following wintering species.

Over winter:	
Dark-bellied Brent Goose *Branta bernicla bernicla*	2,847 individuals representing 0.9% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6)
Black-tailed godwit *Limosa limosa islandica*	31 individuals representing 0.4% of the population in Great Britain (5 year peak mean 1991/92-1995/96)
Dunlin *Calidris alpine alpina*	5123 individuals representing 1% of the population in Great Britain 5 year peak mean 1991/92-1995/96
Red-breasted merganser *Mergus serrator*	87 individuals representing 0.9% of the population in Great Britain (5 year peak mean 1991/92-1995/96)

The Site Improvement Plan (SIP043) states that nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,

- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.4.3 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-12 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-12 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Portsmouth Harbour Ramsar and SPA

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Branta bernicla bernicla (Western Siberia/Western Europe) - Dark-bellied brent goose	**20**	Not sensitive	**3**
Mergus serrator (North-western/Central Europe) - Red-breasted merganser	**20**	Not sensitive	**3**
Calidris alpina alpina (Northern Siberia/Europe/Western Africa) - Dunlin	**20**	Not sensitive	**3**
Limosa limosa islandica (Iceland - breeding) - Black-tailed godwit	**20**	Not sensitive	**3**

Consideration of in-combination effects

The Portsmouth Harbour Ramsar and SPA designated sites are contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-13 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

None of the qualifying features of the site are sensitive to acid deposition, meaning that likely significant effects from this pollutant can be ruled out. The remaining 3 pollutants are predicted to exceed the 1% screening threshold for the Fareham 2023 DM Scenario and therefore likely significant effects from air

quality impacts cannot be ruled out for these pollutants. Therefore, a Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-13 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Grasslanda[a]	20	4.78	23.9%
Acid deposition (kEq/ha-year)	Grassland[a]	Not sensitive	0.34	n/a
Airborne NOx (µg/m^3)	n/a	30	5.12	17.1%
Airborne NH_3 (µg/m^3)	n/a	3	0.88	29.2%

[a]This site is characterized by marine habitats with short vegetation, therefore grassland deposition rates are applicable.

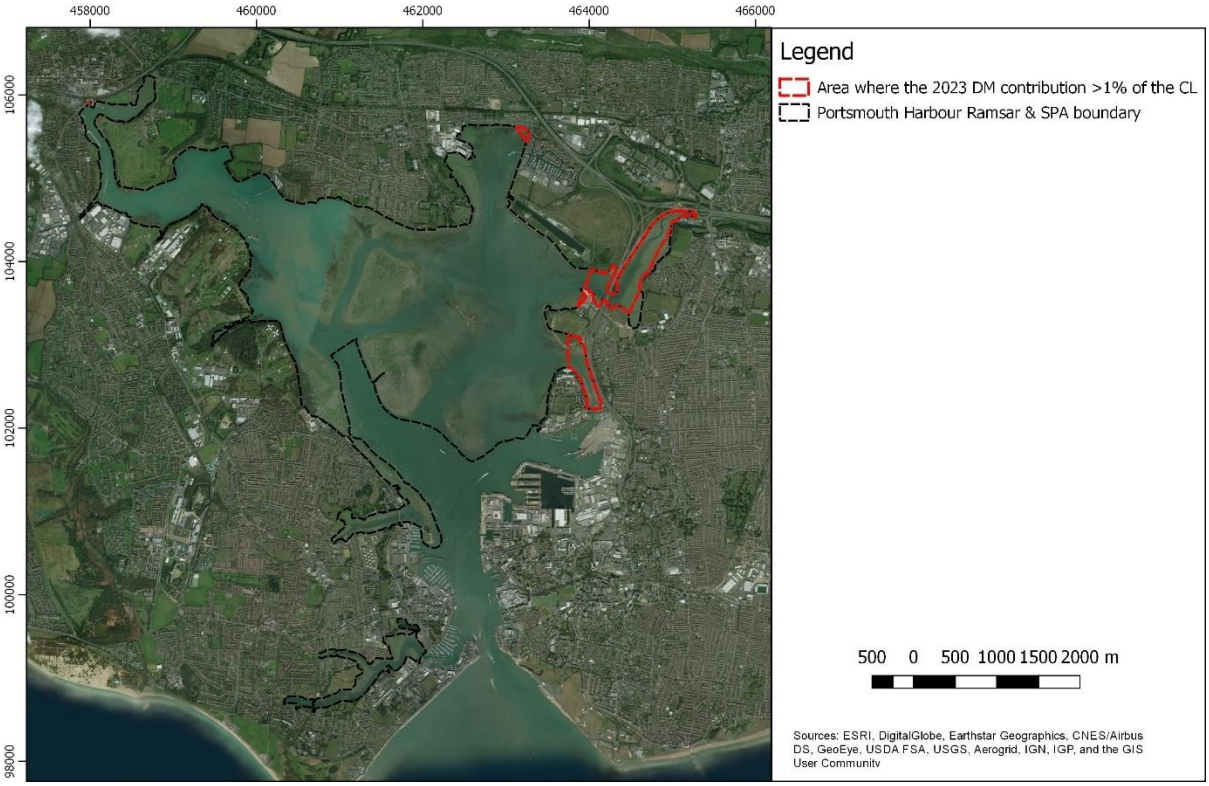
3.4.4 HRA Stage 2: Appropriate Assessment

3.4.4.1 Airborne NH_3

The relevant CL for Portsmouth Harbour Ramsar and SPA is 3 µg/m^3 for all features.

The following figure illustrates the areas where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.03 µg/m^3 (1% of 3 µg/m^3). Four areas of exceedance were identified: one small area in the West, and three larger areas in the East of the site.

Figure 3-14 Overview of screening results for airborne ammonia at Portsmouth Harbour Ramsar & SPA, assuming a CL of 3 µg/m^3



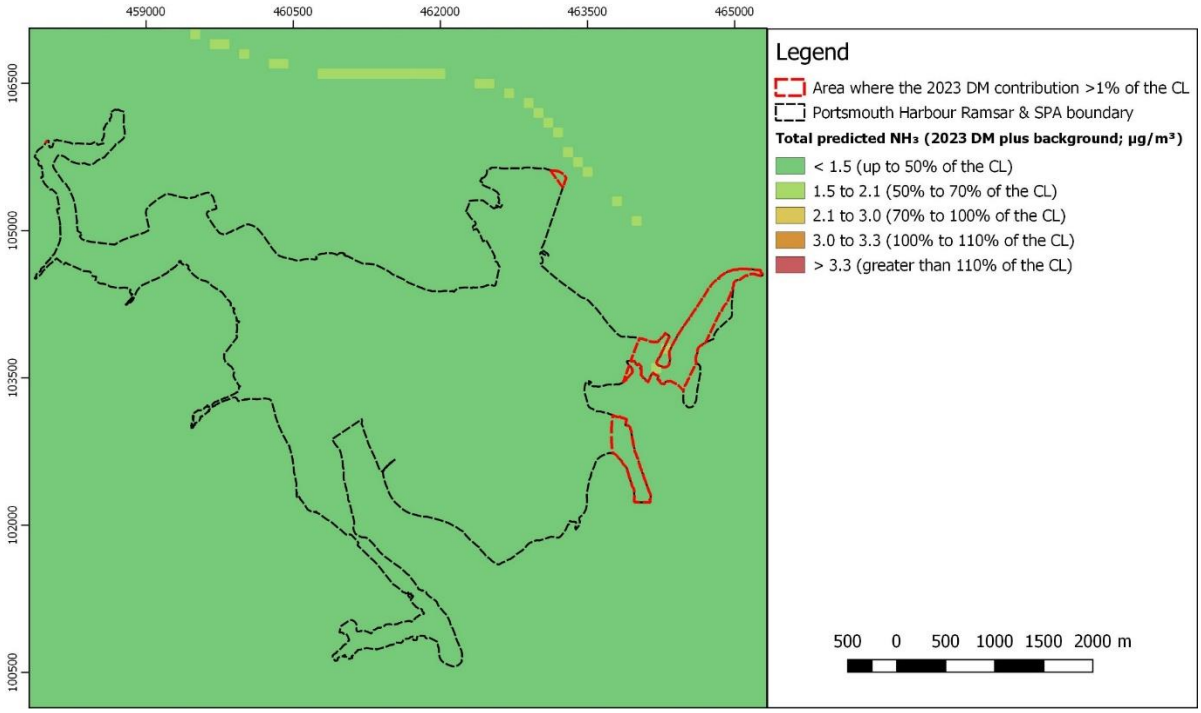
Consideration of background concentrations

Figure 3-15 shows the results of the Fareham 2023 DM model scenario added to the 2013-2015 background NH_3 concentrations from APIS.[56]

The predicted NH_3 concentration does not exceed the CL of 3 µg/m^3 anywhere within the designated site boundary. In this case, the maximum predicted concentration was 1.94 µg/m^3 (64.7% of the CL).

On the basis of available evidence and agreed thresholds, there are no adverse effects on this Ramsar and SPA site arising from increased airborne NH_3 concentrations associated with the Fareham 2023 DM development scenario.

Figure 3-15 Total modelled concentrations of airborne ammonia at Portsmouth Harbour Ramsar & SPA in 2023, assuming a CL of 3 µg/m^3



3.4.4.2 Nitrogen deposition

Figure 3-16 illustrates the areas where the modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.2 kgN/ha-year (1% of the lowest CL). Four areas of exceedance were identified: one small area in the West, and three larger areas in the East of the site.

Summary of critical loads:

- Black-tailed godwit is listed as “sensitive due to nutrient nitrogen impacts on broad habitat” on APIS, for a broad habitat type of pioneer, low-mid and mid-upper saltmarshes, with a CL range of 20 – 30 kgN/ha-year.
- Red-breasted merganser is listed as not being sensitive to nutrient nitrogen impacts on broad habitat, although the broad habitat itself is sensitive to nutrient nitrogen impacts. The CL range is the same (20 – 30 kgN/ha-year for broad habitat type – Pioneer, low-mid, upper-mid saltmarshes).

[56] http://www.apis.ac.uk/popup/gridded-concentration-deposition-2015?sitecode=UK9011011&deptype=M&featurecode=A137&accode=AG (accessed 10/09/2019)

- APIS[57] provides additional guidance for nitrogen deposition on saltmarshes for detailed assessments: "Effects are most likely to be found in the tall vegetation of the closed upper marsh communities where inter-specific competition is at its greatest. Therefore, it is suggested that the value of 30 kgN/ha-year is applied to most of the mash with the lower level of 20 kgN/ha-year being applied to the more densely vegetated upper marsh and to areas of marsh subjected to direct run-off from adjacent catchments."

Figure 3-16 Overview of screening results for nitrogen deposition at Portsmouth Harbour Ramsar & SPA, assuming grassland deposition rates and a CL of 20 kgN/ha-year

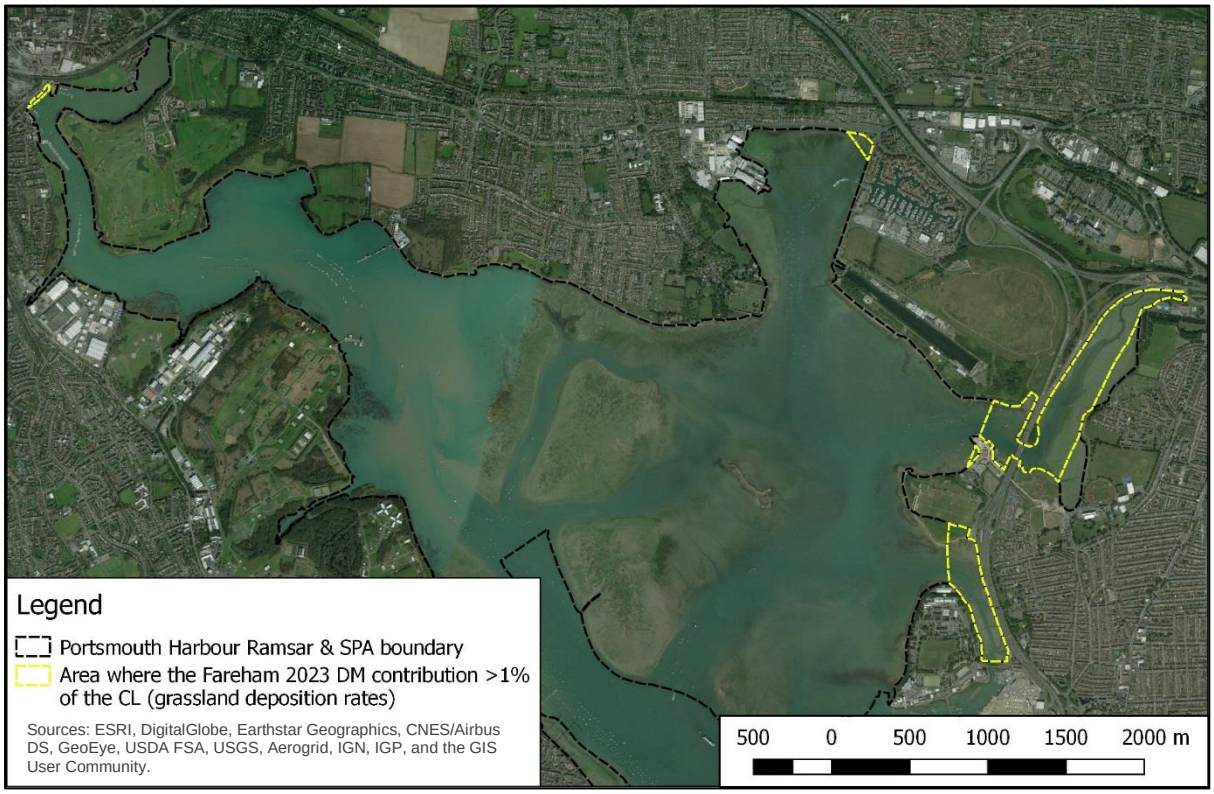


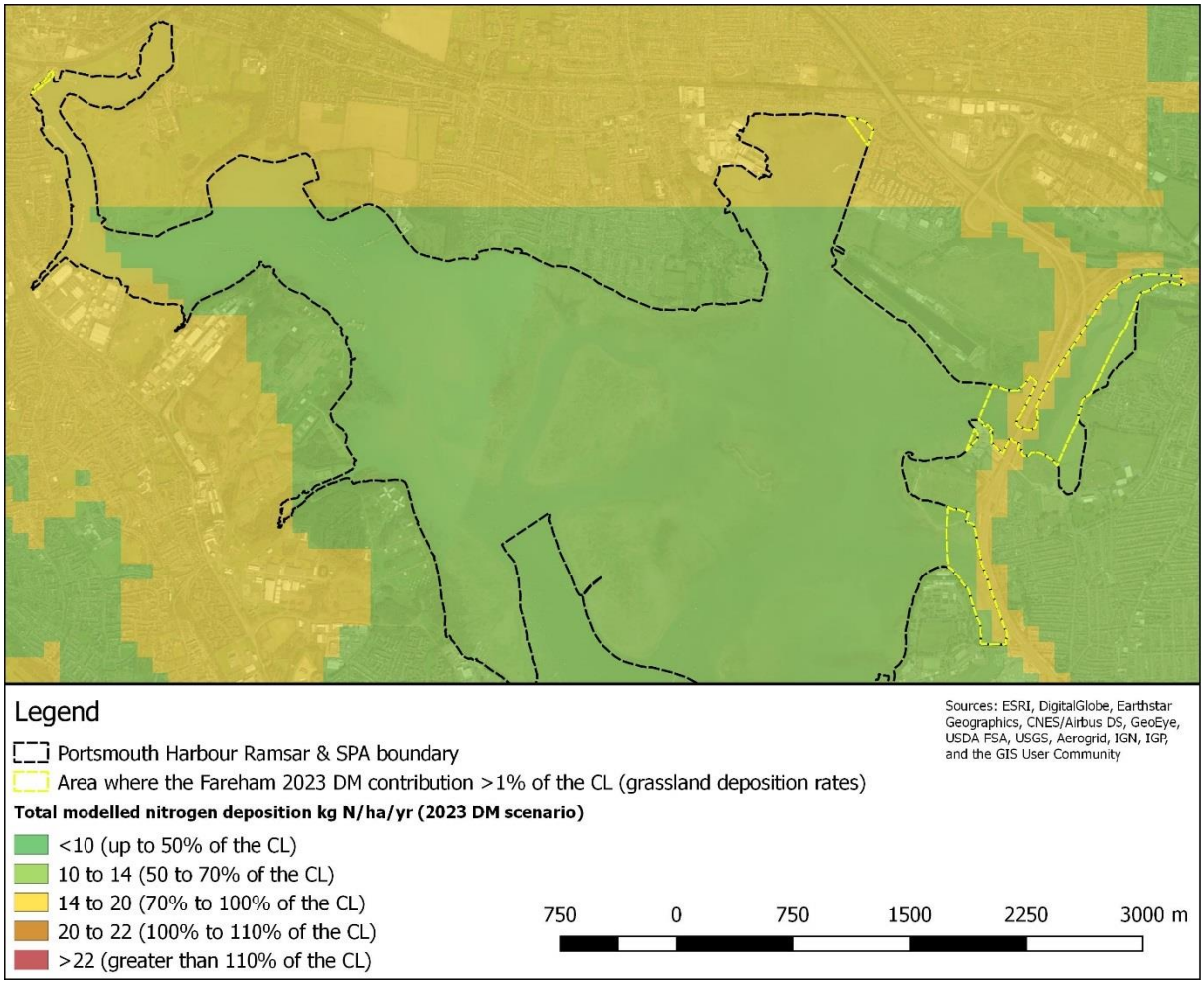
Figure 3-17 shows the modelled Fareham 2023 DM contribution to nitrogen deposition added to the background concentrations[58] of nitrogen deposition throughout the site. The predicted total nitrogen deposition does not exceed the CL of 20 kgN/ha-year anywhere within the designated site boundary. In this case, the maximum total modelled nitrogen deposition, assuming grassland deposition rate, is 17.51 kgN/ha-year (87.6% of the CL).

On the basis of available evidence, including the current background levels of nitrogen deposition, there are no adverse effects on this Ramsar and SPA site arising from the increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

[57] http://www.apis.ac.uk/sites/default/files/downloads/APIS%20critical_load_range_document.pdf, p. 1

[58] Site/Feature Information, Portsmouth Harbour, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK9011051&deptype=G&featurecode=A069&accode=NSH, accessed 16/08/2019.

Figure 3-17 Areas where the modelled DM contribution exceeds 1% of the CL and total modelled nitrogen deposition, assuming grassland deposition rates and a CL of 20 kgN/ha-year, at Portsmouth Harbour Ramsar & SPA



3.4.4.3 Airborne NOx

The relevant CL for Portsmouth Harbour Ramsar and SPA is 30 µg/m^3 for all vegetation.

Figure 3-18 illustrates the areas where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of 30 µg/m^3). Four areas of exceedance were identified: three smaller areas of Fareham Creek, Port Solent, and Gosport, and the larger area of Tipner Lake.

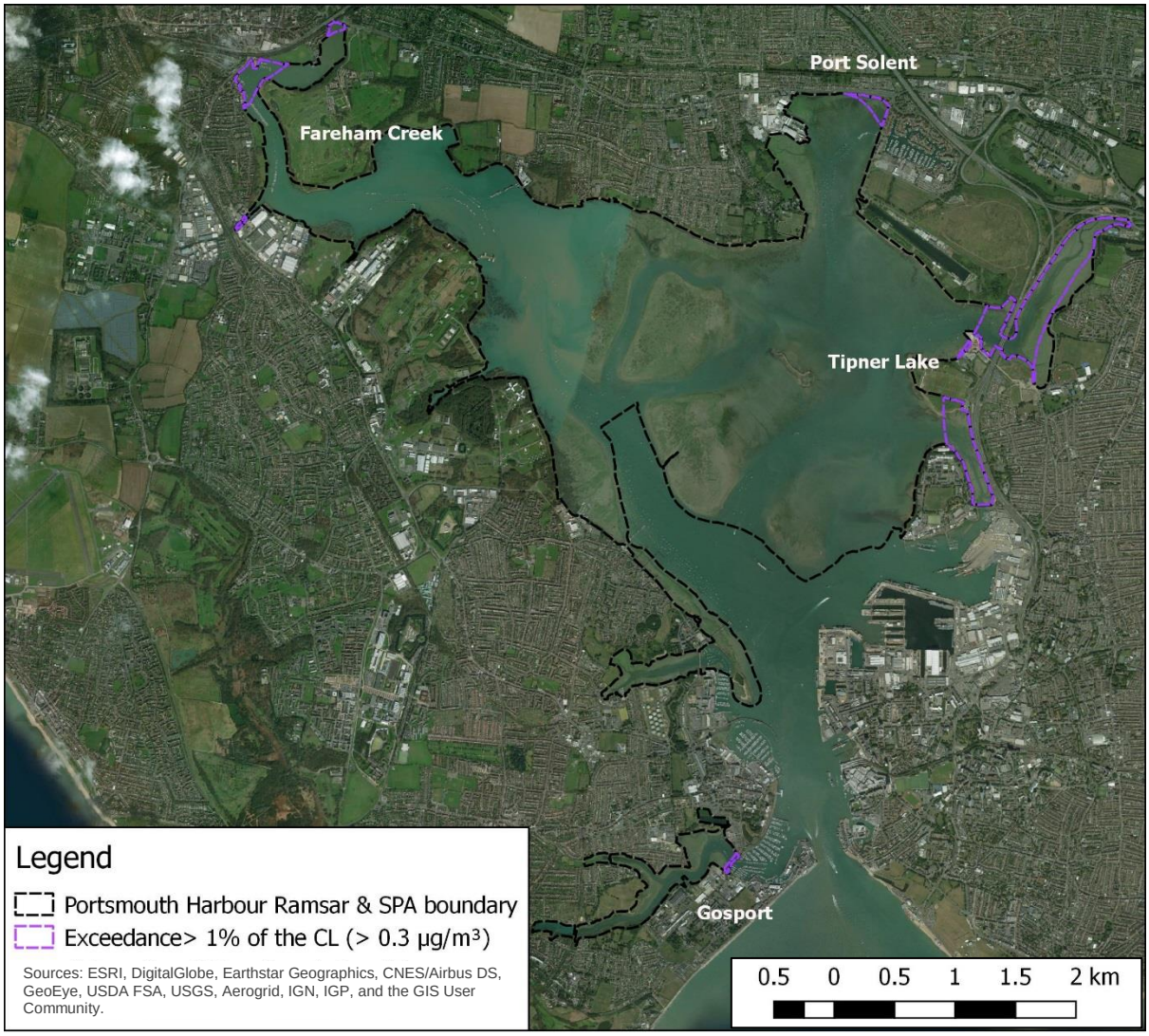
Of the areas predicted to exceed the screening threshold in Portsmouth Harbour, the majority correspond with areas of intertidal mudflats. These would be regularly flushed with tidal water; this is supported by the Mean High Water mark, which these habitats lie below.[42] Therefore, it is not anticipated that air pollution would be able to build up in these areas. For the remaining areas, which would not be routinely flushed with water, total NOx concentrations are considered.

Consideration of background concentrations

The areas of exceedance which would not routinely be flushed with water are at Hoeford Lake (south of Fareham Creek) and south of Tipner Lake, shown in Figure 3-19 and Figure 3-20, respectively.

The area of Hoeford Lake is very small, with the area predicted to exceed both in terms of DM contribution greater than 1% of the CL and total concentration greater than 30 µg/m^3 measuring less than 0.02 ha. Some of this area would also be regularly inundated with water, as shown by the Mean

Figure 3-18 Overview of screening results for oxides of nitrogen (NOx) at Portsmouth Harbour Ramsar & SPA



High Water mark[42] (Figure 3-19) although there is not sufficient priority habitat information to determine which habitat(s) would be affected.

The area of Coastal saltmarsh where total modelled airborne NOx exceeds the CL in Tipner Lake is very small (~5 m^2; circled in white on Figure 3-20) and constitutes a small percentage of the total area of coastal saltmarsh in the designated site that might be used by the qualifying features. The Ramsar designation of Portsmouth Harbour[59] does not list coastal saltmarsh as a qualifying feature.

Natural England have confirmed that given the small areas of exceedance at Hoeford Lake and Tipner Lake and taking into consideration that they fall outside of key SPA roosting and foraging areas as identified by the Solent Waders and Brent Goose Strategy, it is agreed that these exceedances can be ruled out in relation to the SPA.[40]

On the basis of available evidence, there are no adverse effects on this Ramsar and SPA site arising from increased airborne NOx associated with the Fareham 2023 DM development scenario.

[59] Ramsar Information Sheet (RIS), Portsmouth Harbour, https://rsistest.ramsar.org/RISapp/files/RISrep/GB720RIS.pdf, accessed 03/10/2019.

Figure 3-19 Area where the DM contribution exceeds 1% of the CL, and total modelled concentration exceeds 30 µg/m³ for NOx at Portsmouth Harbour Ramsar & SPA: Hoeford Lake (south of Fareham Creek)

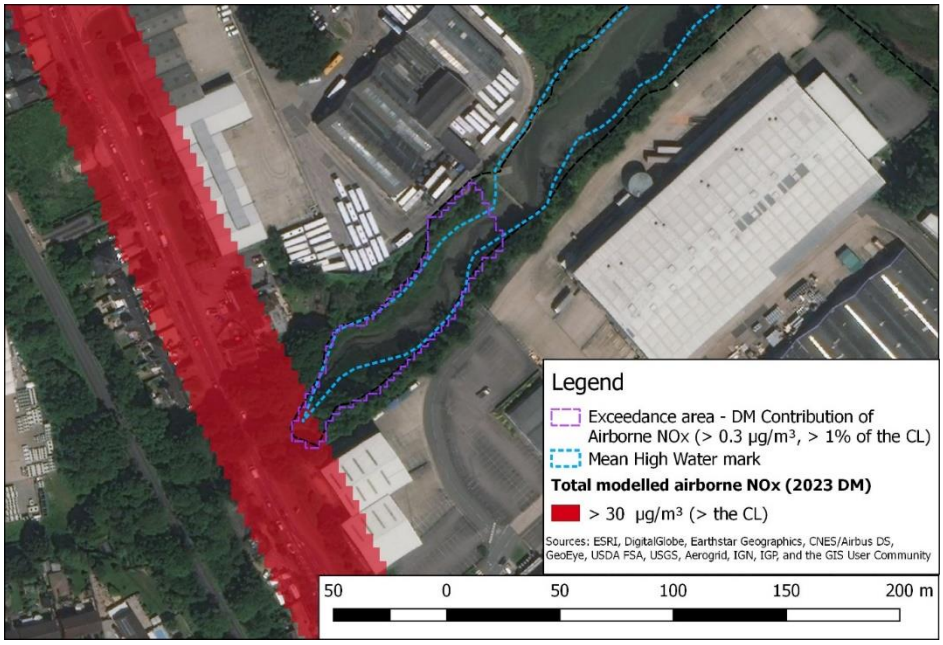
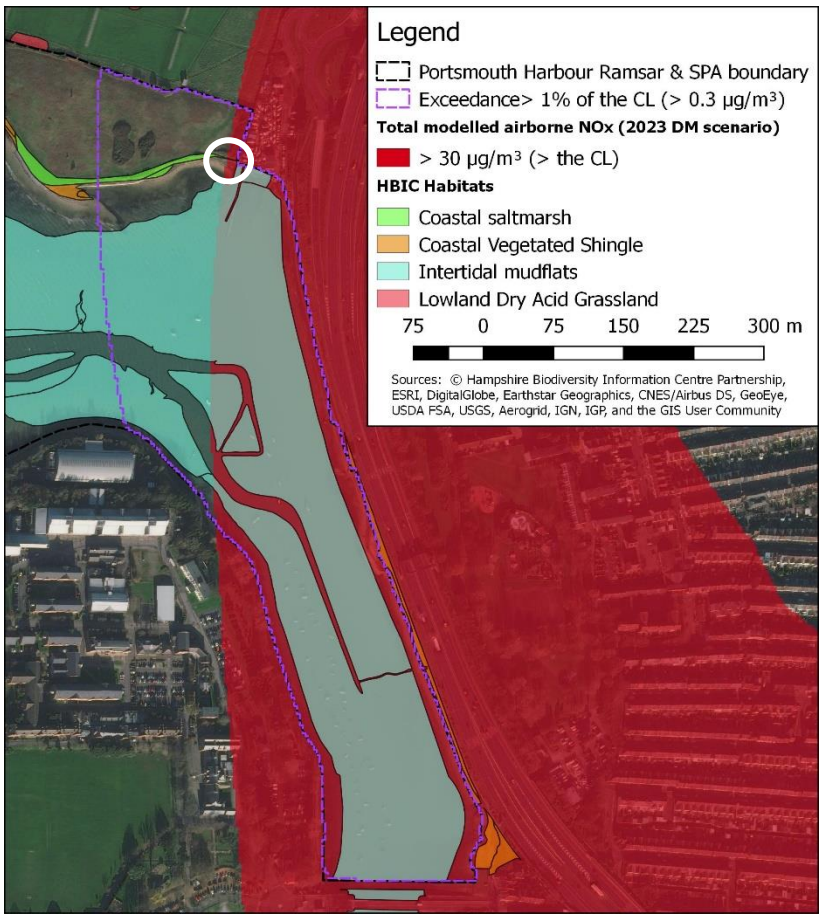


Figure 3-20 Area where the DM contribution exceeds 1% of the CL, and total modelled concentration exceeds 30 µg/m³ for NOx at Portsmouth Harbour Ramsar & SPA: Southern part of Tipner Lake



3.4.4.4 Detailed consideration of qualifying features

Each qualifying feature of Portsmouth Harbour is considered in-turn in Table 3-14.

Table 3-14 Detailed consideration of qualifying features for Portsmouth Harbour Ramsar & SPA

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
Ramsar Criterion 3:	The intertidal mudflat areas possess extensive beds of eelgrass *Zostera angustifolia* and *Zostera noltei* which support the grazing dark-bellied brent geese *Branta bernicla bernicla* populations. The mud-snail *Hydrobia ulvae* is found at extremely high densities, which helps to support the wading bird interest of the site. Common cord-grass *Spartina anglica* dominates large areas of the saltmarsh and there are also extensive areas of green algae *Enteromorpha* spp. and sea lettuce *Ulva lactuca*. More locally the saltmarsh is dominated by sea purslane *Halimione portulacoides* which gradates to more varied communities at the higher shore levels. The site also includes a number of saline lagoons hosting nationally important species. Saltmarsh is listed on APIS as supporting habitat for dark-bellied Brent goose which is sensitive to air pollution impacts. As such, the common cord-grass, sea purslane, green algae and sea lettuce will be considered under the saltmarsh habitat type along with dark bellied Brent goose under Ramsar Criterion 6 below. A review of HBIC and priority habitat mapping (PHI) datasets did not identify any eelgrass beds within the areas of exceedance and as such adverse impacts from pollutants to this qualifying feature habitat as a result of short-term development in Fareham Borough are considered unlikely. The mud-snail occupies habitats between the upper littoral fringe and the lower infralittoral zone. Given that the species occupies the littoral zone at its upper extent, impacts to supporting habitat will be under the saltmarsh habitat type along with dark bellied Brent goose under Ramsar Criterion 6 below. A review of HBIC and priority habitat mapping did not identify any saline lagoons within the areas of exceedance and as such adverse impacts from pollutants to this qualifying feature habitat as a result of short-term development in Fareham Borough are considered unlikely.	No
Ramsar Criterion 6: Dark-bellied Brent Goose	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. <u>NOx</u> Species is sensitive to impacts to supporting habitat from airborne NOx. There are small areas of exceedance at Hoeford Lake and Tipner Lake, however these fall outside of key SPA roosting and foraging areas as identified by the Solent Waders and Brent Goose Strategy. As such adverse impacts from pollutants to this qualifying feature habitat resulting from short-term development in Fareham Borough are considered unlikely.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
Black Tailed godwit	Supporting habitat type and habitat sensitivities as per Dark-bellied Brent goose.	No
Dunlin	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that although the supporting habitat is sensitive to air pollutants, the species itself is not impacted through impact to habitat.	No
Red-breasted merganser	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, or airborne NH_3. NOx APIS indicates that there is “no expected negative impact on species due to impacts on the species’ broad habitat”.	No

3.4.4.5 Assessment summary and conclusions

Adverse effects (pre-mitigation) can be discounted for all qualifying features of the Portsmouth Harbour Ramsar and SPA, and for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

On the basis of available evidence, adverse effects on this Ramsar and SPA site can be discounted and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

3.5 River Itchen SAC (UK0012599)

3.5.1 SAC background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): River Itchen SSSI

Qualifying and notifiable features associated with this site comprise: 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation,* 1044 (*Coenagrion mercuriale*) Southern damselfly, 1092 (*Austropotamobius pallipes)* White-clawed (or Atlantic stream) crayfish, 1096 (*Lampetra planeri*) Brook lamprey, 1106 (*Salmo salar*) Atlantic salmon, 1163 (*Cottus gobio*) Bullhead and 1355 (*Lutra lutra*) Otter.

The conservation objectives stated for this are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

3.5.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the screening assessment described in Section 2.4.

Table 3-15 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-15 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for River Itchen SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	No data – Species broad habitat sensitive	No data	Site specific advice should be sought
Coenagrion mercuriale - Southern damselfly	**15** [a]	Not sensitive [a]	**3**
Austropotamobius pallipes - White-clawed (or Atlantic stream) crayfish	No data – Species broad habitat sensitive	No data	**3**
Lampetra planeri - Brook lamprey	No data – Species broad habitat sensitive	No data	**3**
Salmo salar - Atlantic salmon	No data – Species broad habitat sensitive	No data	**3**

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs ($\mu g/m^3$)
Cottus gobio - Bullhead	No data – Species broad habitat sensitive	No data	**3**
Lutra lutra - Otter	No data – Species broad habitat sensitive	No data	**3**

[a] *Coenagrion mercuriale* - Southern damselfly (S1044) is the only feature listed on APIS with a CL for nutrient nitrogen deposition (CL range is 10-20 kgN/ha/year) and acid deposition (MinCLMaxN is 0.922 kEq/ha/year), both associated with the broad habitat Dwarf shrub heath. Within the River Itchen SAC, the Southern damselfly is found in a managed chalk-river flood plain[60], which is better described as the EUNIS habitat classification Rich fens (EUNIS D4.1) rather than Dwarf shrub heath (EUNIS F4.11). According to APIS, the Rich fens habitat has a CL for nutrient nitrogen of 15-30 kgN/ha-year and is not sensitive to acid deposition. This approach has been confirmed with Natural England and is consistent with the approach taken in the Eastleigh Local Plan HRA.[61]

Consideration of in-combination effects

The River Itchen SAC designated sites is contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-16 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

None of the qualifying features of the site are sensitive to acid deposition, meaning that likely significant effects from this pollutant can be ruled out. The remaining 3 pollutants are predicted to exceed the 1% screening threshold for the Fareham 2023 DM Scenario, and therefore likely significant effects from air quality impacts cannot be ruled out for these pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-16 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Forest	15	1.87	12.5%
	Grassland	15	1.21	8.1%
	Forest	Not sensitive	0.13	n/a

[60] JNCC, "1044 Southern damselfly *Coenagrion mercuriale*", https://sac.jncc.gov.uk/species/S1044/, accessed 12/08/2019.

[61] Urban Edge Environmental Consulting, "Habitats Regulations Assessment for the Eastleigh Borough Local Plan 2016 – 2036, Revised HRA Report following representations on the Proposed Submission Plan", October 2018.

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Acid deposition (kEq/ha-year)	Grassland	Not sensitive	0.086	n/a
Airborne NOx (µg/m^3)	n/a	30	3.62	12.1%
Airborne NH_3 (µg/m^3)	n/a	3	0.21	7.0%

This designated site is mainly characterised by short vegetation and in those areas the grassland deposition rates are applicable. There are also small areas where trees are present and in these areas forest deposition rates are applicable.

3.5.3 HRA Stage 2: Appropriate Assessment

3.5.3.1 Airborne NH_3

The relevant CL for River Itchen SAC is 3 µg/m^3 for all features.

Dispersion modelling of the Fareham 2023 DM scenario identified one discrete area where airborne ammonia was predicted to exceed the 1% screening threshold (Figure 3-21) when using a CL of 3 µg/m^3.

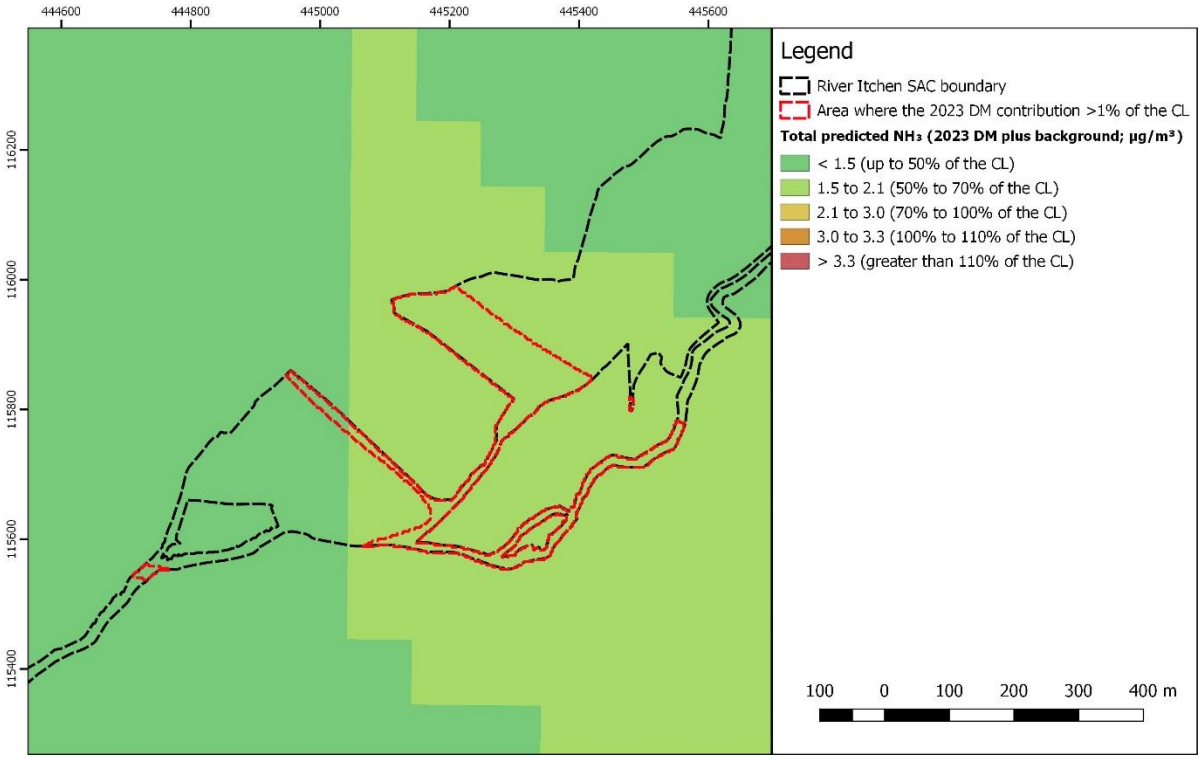
Figure 3-21 Overview of screening results for airborne ammonia at River Itchen SAC

Figure 3-22 shows the results of the Fareham 2023 DM model scenario overlaid with the 2013-2015 background NH_3 concentrations from APIS.[62] The NH_3 concentrations from APIS are on a 5 km x 5 km grid, hence some parts of the figure appear pixelated. The maximum total modelled contribution from the Fareham 2023 DM scenario was 1.84 µg/m^3, which represents 61.3% of the CL and as such a likely significant effect as a result of airborne ammonia can be discounted.

[62] http://www.apis.ac.uk/popup/gridded-concentration-deposition-2015?sitecode=UK9011011&deptype=M&featurecode=A137&accode=AG (accessed 10/09/2019)

On the basis of available evidence, including background ammonia concentrations, there are no adverse effects on this SAC site arising from increased ammonia associated with the Fareham 2023 DM development scenario.

Figure 3-22 Total modelled concentrations of airborne ammonia at River Itchen SAC in 2023



3.5.3.2 Nitrogen deposition

Summary of critical loads:

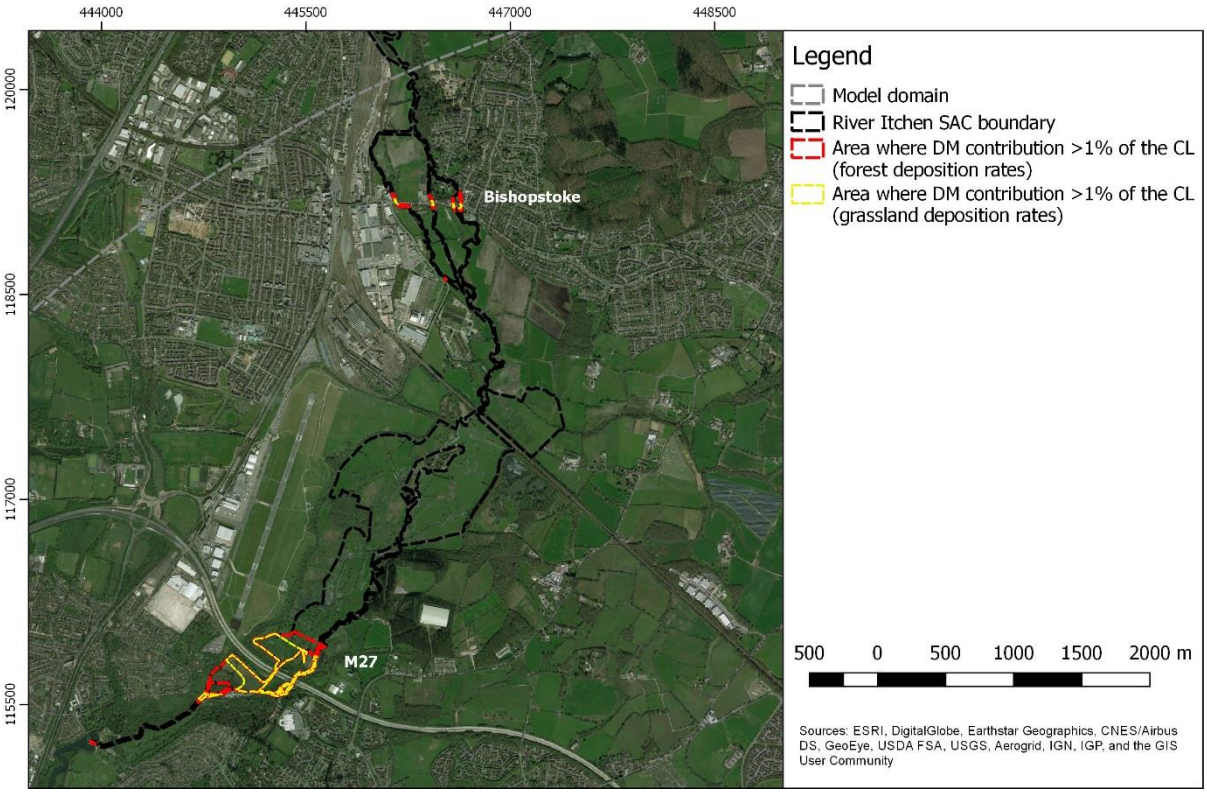
The only quantified CL on APIS is for *Coenagrion mercuriale* (Southern damselfly) due to impacts on its habitat. As discussed earlier in this chapter, this habitat type is best described as Rich fens, with a CL range 15 – 30 kgN/ha-year. All of the other sensitive features listed on APIS are aquatic species with the "rivers and streams" broad habitat; it is not anticipated that air pollution impacts from road traffic would accumulate to a significant degree in this broad habitat.

Figure 3-23 shows the areas of exceedance where the DM 2023 scenario contribution exceeds 1% of the CL for nitrogen deposition (forest and grassland deposition rates).

If forest deposition rates are assumed as a worst-case scenario, four areas of exceedance are identified: large areas at Bishopstoke and where the M27 crosses the river further south, alongside smaller areas of exceedance adjacent to Chicken Hall Lane (behind Barton Park Industrial Estate) and where Woodmill Lane crosses the river at Woodmill Outdoor Activities Centre. When grassland deposition rates are assumed, only the larger exceedance areas are observed, and the affected area is smaller in both instances. As the Rich Fens habitat would be classified as a Grassland habitat type, grassland deposition rates are appropriate throughout most of the site, however there are also some areas with trees.

APIS indicates that the current background nitrogen deposition levels at River Itchen SAC range from 16.38 to 20.30 kgN/ha-year, indicating that the minimum CL for the Southern damselfly (15 kgN/ha-year) is exceeded throughout the site.

Figure 3-23 Overview of screening results for nitrogen deposition at River Itchen SAC, assuming a CL of 15 kgN/ha-year



A summary of previous work undertaken on HRAs for the River Itchen SAC, particularly in support of the Eastleigh Borough Local Plan 2016-2036, is provided in Section 3.5.3.4. The Eastleigh HRA Report[61] considered potential impacts due to changes in air quality, associated with the draft 2016-2036 Eastleigh Borough Local Plan and in-combination with other anticipated housing development, against the River Itchen SAC conservation objectives[61]. The HRA report concluded that changes in air quality were not likely to have a significant effect on any of the site's conservation objectives.

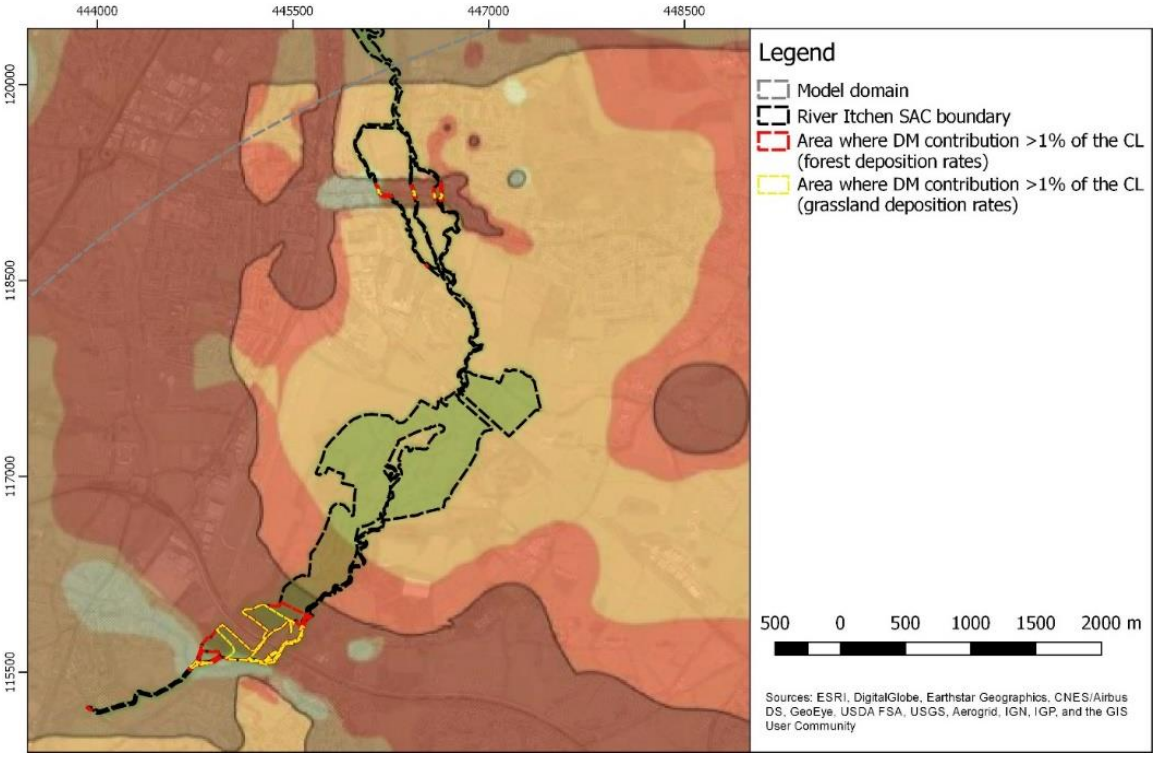
Figure 3-24 compares the areas predicted to exceed the 1% screening threshold in the Eastleigh study (red shading) with the areas predicted to exceed the 1% screening threshold for this study (yellow and red dashed lines). This figure was constructed by using GIS software to georeferenced the results of the Eastleigh study with the results of this study. Further analysis focuses on a comparison of impacts from the Fareham short-term development up to 2023 (in-combination with other development) with the Eastleigh Borough LP development up to 2036 (in-combination with other development):

- The Bishopstoke areas of exceedance are considerably smaller for the Fareham 2023 DM scenario (extending up to approximately 15m from the road edge) than those given in the Eastleigh HRA report (extending up to approximately 90m from the road edge). Therefore, we would expect no adverse effects in those areas resulting from changes in nitrogen deposition, given the conclusions from the Eastleigh HRA.

- The M27 areas of exceedance are slightly different between the modelling studies. However, overall, the areas of exceedance are considerably smaller for the Fareham 2023 DM scenario (extending up to approximately 230m from the road edge) than those given in the Eastleigh HRA report (extending up to approximately 1000m from the road edge). Therefore, we would expect no adverse effects in those areas resulting from changes in nitrogen deposition, given the conclusions from the Eastleigh HRA.

On the basis of available evidence, there are no adverse effects on this SAC site arising from the increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

Figure 3-24 Comparison of 1% screening threshold results for nitrogen deposition for the River Itchen SAC, assuming a CL of 15 kgN/ha-year, between Eastleigh HRA report[61] (red shading) and the current study (red and yellow dashed lines)



3.5.3.3 Airborne NOx

The relevant CL for River Itchen SAC is 30 µg/m^3 for all vegetation. Figure 3-25 illustrates the area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas where the Fareham 2023 DM contribution exceeds 1% of the CL at River Itchen SAC are illustrated in Figure 3-26 and Figure 3-27, for the areas around the M27 and at Bishopstoke, respectively. The total modelled NOx concentration that exceeds 30 µg/m^3 is also shown.

These areas predicted to exceed the 1% screening threshold and have total NOx concentrations greater than 30 µg/m^3 in 2023, are smaller than the areas already considered for nutrient nitrogen deposition impacts. From this, there are no anticipated adverse effects on the Southern damselfly.

The other qualifying features are aquatic species, whose habitat quality is likely to be significantly more sensitive to water quality than air quality. This portion of the River Itchen waterways predicted to experience NOx concentrations greater than 30 µg/m^3 in 2023 is also relatively small, compared to the full extent of the River Itchen.

On the basis of available evidence, there are no adverse effects on this SAC site arising from increased airborne NOx associated with the Fareham 2023 DM development scenario.

Figure 3-25 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at River Itchen SAC

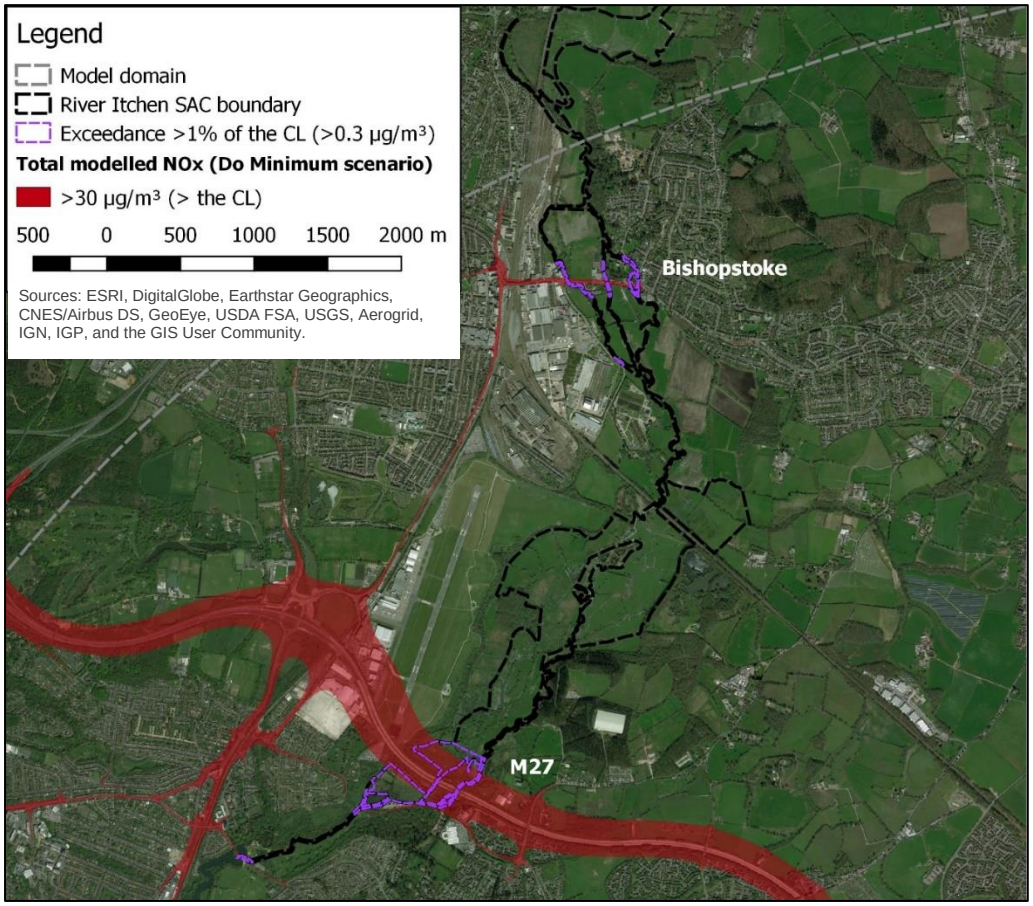


Figure 3-26 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at River Itchen SAC: M27

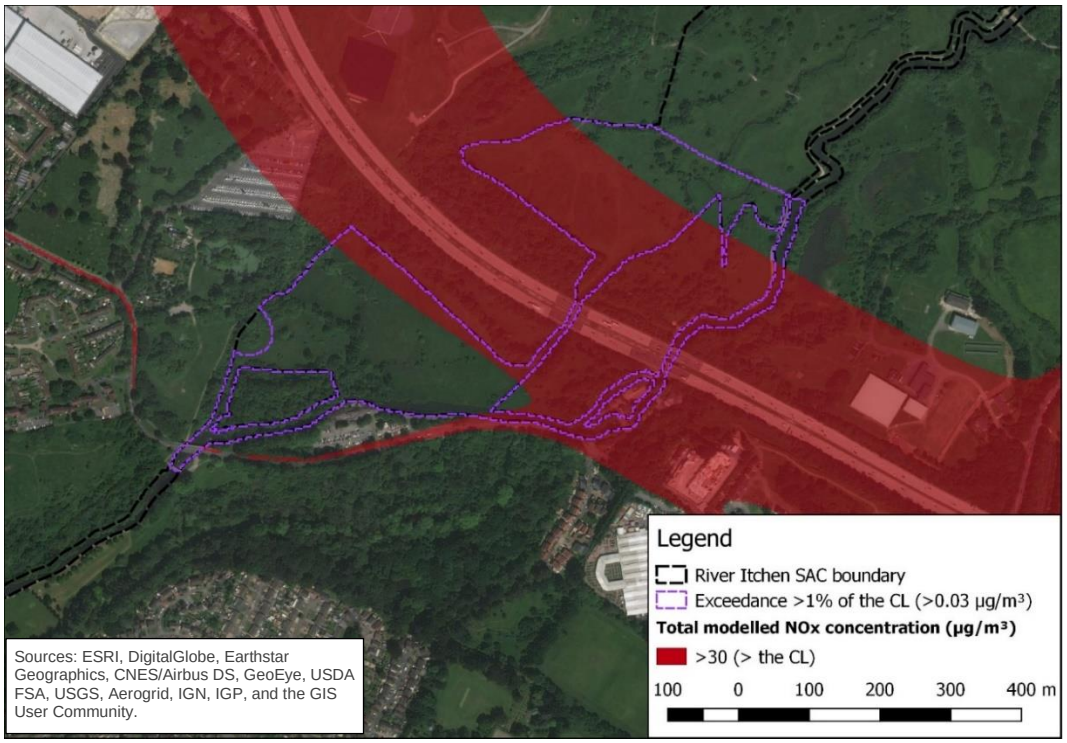
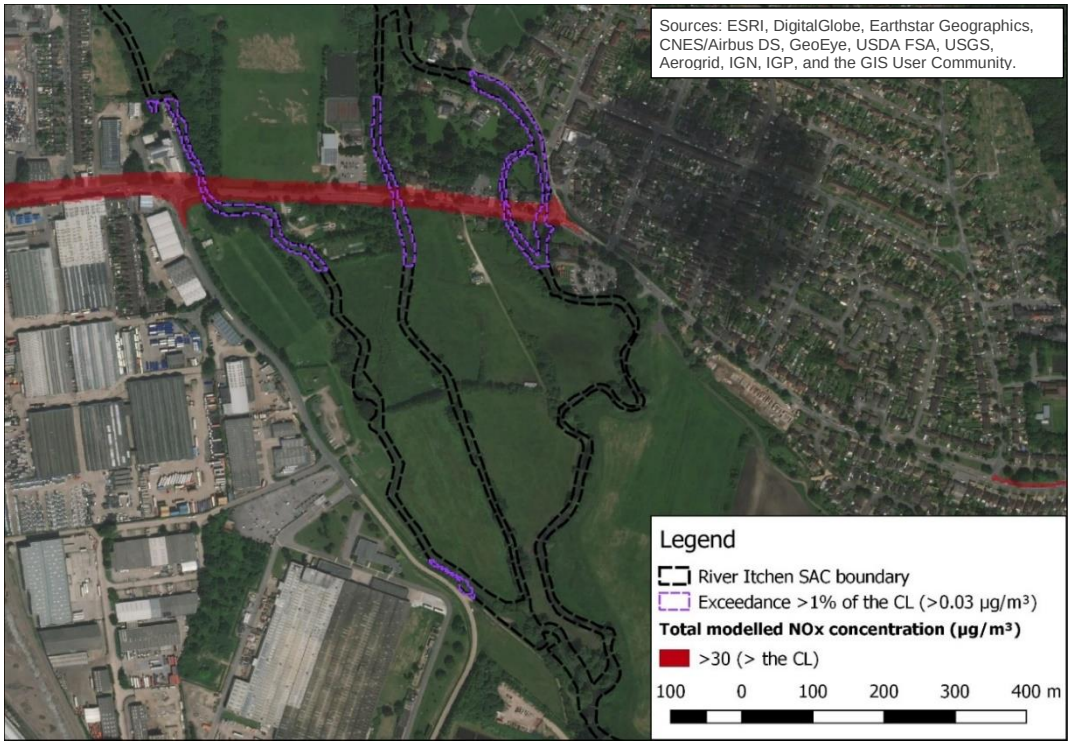


Figure 3-27 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at River Itchen SAC: Bishopstoke



3.5.3.4 Previous work on the River Itchen SAC

This section provides an overview of previous work that has been undertaken on the River Itchen SAC.

The Eastleigh Borough Local Plan Revised HRA Report October 2018[61] includes an appropriate assessment of the air quality impacts of nutrient nitrogen deposition on the Southern damselfly. The appropriate assessment included mapping of the area predicted to exceed the 1% screening threshold (for the draft 2016-2036 Eastleigh Borough Local Plan, in-combination with other anticipated housing development); consideration of population transects for the Southern damselfly recorded by Rushbrook in 2017[63]; and site visits conducted in support of the Eastleigh HRA appropriate assessment.

Figure 3-28 is reproduced from the Eastleigh HRA study[61] (see Figure 7.3 in that report), and shows the area predicted to exceed the 1% screening thresholds (shaded in red) along with transects surveyed for Southern damselfly in 2017. As part of the analysis for the Eastleigh HRA, some Southern damselfly transects identified in 2017 were examined, particularly at Bishopstoke and the M27 crossing:

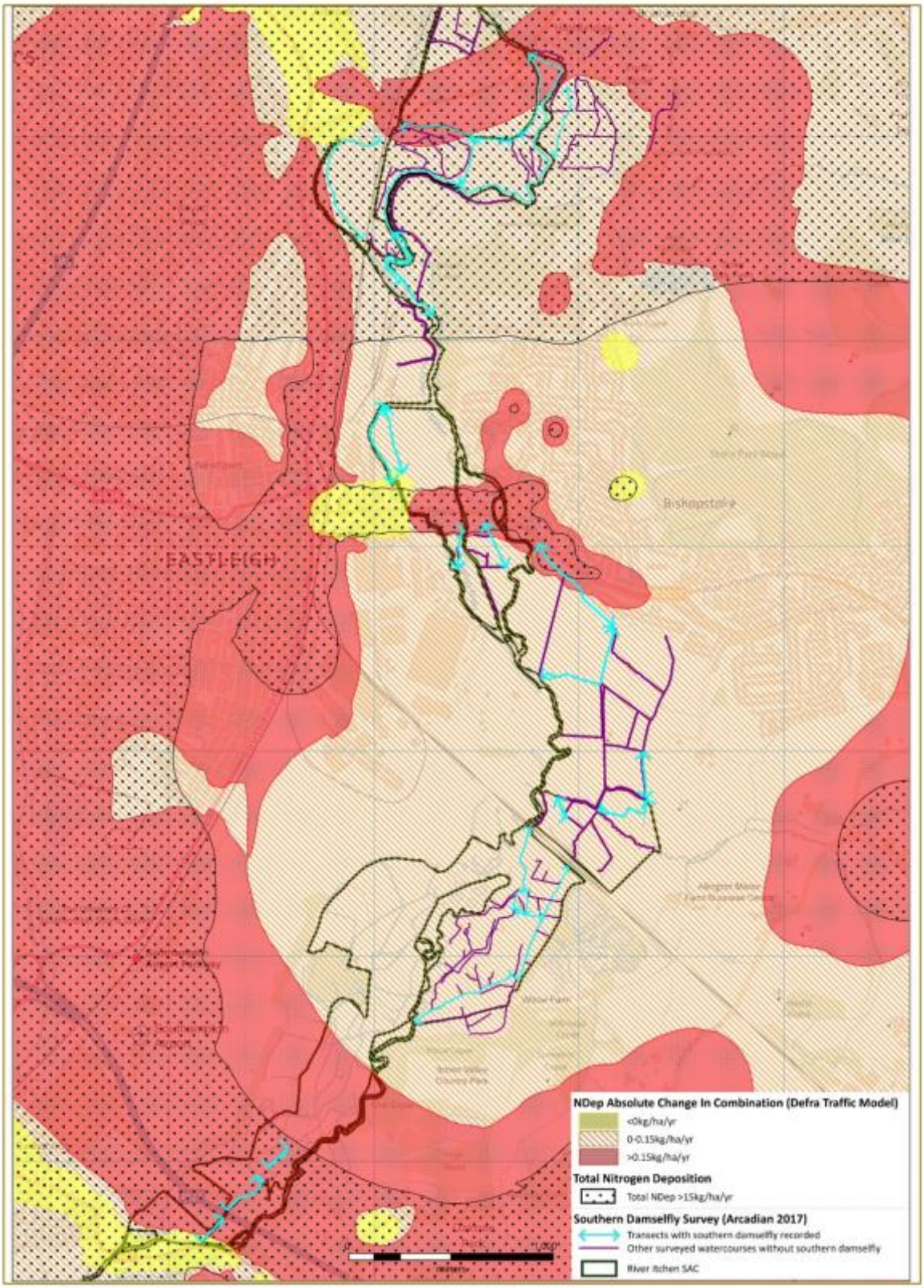
- At Bishopstoke, transects were examined just south of the exceedance areas (those areas shaded in red in Figure 3-28). Although these transects did not lie within the SAC, the site is described as having an important role in maintaining the range and meta population of southern damselfly in the Itchen Valley. No evidence of any nutrient enrichment or eutrophication of the marginal habitat due to proximity to the Bishopstoke Road was found.

- Where the M27 crosses the River Itchen there are two areas of exceedance for which transects were examined. North of the motorway, the habitat was found to be in relatively poor condition for the southern damselfly with marginal vegetation dominated by tall reed and sedge species. A similar situation was found south of the M27 crossing. In both cases, the soft fleshy aquatic

[63] Rushbrook, B. "Southern damselfly survey and habitat assessment study: Eastleigh Borough", 2017, Arcadian Ecology & Consulting Ltd.

plants preferred for egg laying by southern damselflies were rare or absent and tall fen vegetation dominated.

Figure 3-28 Distribution of southern damselfly transects in relation to NDep 15kg/ha-year critical load for Rich Fen and 1% exceedance contour in the lower Itchen Valley. In combination assessment using Defra traffic model. Reproduced from the Eastleigh HRA study[61]



The Eastleigh HRA Report concluded that there was no apparent transition or gradient in marginal swamp vegetation (the habitat on which the southern damselfly relies on for egg laying) composition or structure related to the distance from either the Bishopstoke Road or the M27. The vegetation is affected more greatly by fluvial processes such as sediment deposition, bank shading and vegetation management intervention, than by small changes in nitrogen deposition. Therefore, the predicted changes in nitrogen deposition arising from changes in road traffic were considered to be insignificant.

The Eastleigh HRA Report considered potential impacts due to changes in air quality, associated with the draft 2016-2036 Eastleigh Borough Local Plan and in-combination with other anticipated housing development, against the River Itchen SAC conservation objectives (see Table 7.3 in that report[61]). The HRA report concluded that changes in air quality were not likely to have a significant effect on any of the site's conservation objectives.

The Eastleigh HRA is currently going through an examination and Natural England has no live objections to the HRA.

3.5.3.5 Detailed consideration of qualifying features

Each qualifying feature of the River Itchen SAC is considered in-turn in Table 3-17.

Table 3-17 Detailed consideration of qualifying features for River Itchen SAC

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Vegetation is affected more greatly by fluvial processes such as sediment deposition, bank shading and vegetation management intervention rather than nitrogen deposition. Therefore, the predicted changes in nitrogen deposition and airborne NOx are considered to be insignificant. The maximum total modelled contribution of airborne ammonia was 1.84 µg/m^3, which represents 61.3% of the CL and as such a likely significant effect can be discounted.	No
1044 Southern damselfly	Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
1163 Bullhead	Supporting habitat is sensitive to pollutants, but species itself is not impacted through impact to habitat and significantly more sensitive to water quality than air quality. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
1092 White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*	Supporting habitat is sensitive to pollutants, but species itself is not impacted through impact to habitat and significantly more sensitive to water quality than air quality. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
1096 Brook lamprey *Lampetra planeri*	Supporting habitat is sensitive to pollutants, but species itself is not impacted through impact to habitat and significantly more sensitive to water quality than air quality. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
1106 Atlantic salmon *Salmo salar*	Supporting habitat is sensitive to pollutants, but species itself is not impacted through impact to habitat and significantly more sensitive to water quality than air quality. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
1355 Otter *Lutra lutra*	Supporting habitat is sensitive to pollutants, but species itself is not impacted through impact to habitat and significantly more sensitive to water quality than air quality. Analysis in the preceding sections determined that there would be no adverse effect related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No

3.5.3.6 Assessment summary and conclusions

Adverse effects (pre-mitigation) can be discounted for all qualifying features of the River Itchen SAC, and for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

On the basis of available evidence, adverse effects on this SAC site can be discounted and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

3.6 Solent and Dorset Coast potential SPA (UK9020330)

3.6.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI):

South Dorset Coast SSSI, Townsend SSSI, Purbeck Ridge (West & East) SSSI, Studland Cliffs SSSI, Studland & Godlingson SSSI, Poole Bay Cliffs SSSI, Christchurch Harbour SSSI, Avon Valley (Bickton to Christchurch) SSSI, River Avon SSSI, Christchurch Harbour SSSI, Highcliffe to Milford Cliffs SSSI, Hurst Castle and Lymington River Estuary SSSI, North Solent SSSI, Dibden Bay SSSI, Hythe to Calshot Marshes SSSI, Lee-on-Solent to Itchen Estuary SSSI, Titchfield Haven SSSI, Browndown SSSI, Portsmouth Harbour SSSI, Chichester Harbour SSSI, Langstone Harbour SSSI, Sinah Common SSSI, Bracklesham Bay SSSI, Pagham Harbour SSSI, Bognor Reef SSSI, Compton Chine to Steephill Cove SSSI, Compton Down SSSI, Headon Warren and West High Down SSSI, Colwell Bay SSSI, Yar Estuary SSSI, Bouldnor and Hamstead Cliffs SSSI, Newtown Harbour SSSI, Thorness Bay SSSI, King's Quay Shore SSSI, Ryde Sands and Wootton Creek SSSI, Brading Marshes to St Helen's Ledges SSSI, Whitecliff Bay and Bembridge Ledges SSSI, Bembridge Down SSSI.

Qualifying and notifiable features associated with this site include: Sandwich tern *Sterna sandvicensis* (4.01% of GB breeding population), common tern *Sterna hirundo* (4.77% of GB breeding population) and little tern *Sterna albifrons* (3.31% of GB breeding population).

As this site is only a potential SPA it does not yet have a Site Improvement Plan associated with it. Critical Loads do not apply over the sea where the vast majority of this SPA is located.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

3.6.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-18 summarizes all of the critical loads and critical levels (CLs) used for the screening assessment of this potential SPA. As this is a potential designated site, CLs are not yet listed on APIS. The CLs in the table were agreed with Natural England for screening purposes, based on the qualifying features of this site (tern species) and critical loads applicable to terns at adjacent designated sites.

Table 3-18 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Solent and Dorset Coast potential SPA

Pollutant	Critical load or critical level (CL)	Rationale
Nutrient nitrogen deposition	**8** kgN/ha/year	Based on the minimum CL set for tern species and their supporting habitats at nearby designated sites: Chichester & Langstone Harbours SPA, Solent & Southampton Water SPA
Acid deposition	**0.626** kEq/ha/year	Based on the minimum CL set for tern species and their supporting habitats at nearby designated site: Solent &

Pollutant	Critical load or critical level (CL)	Rationale
		Southampton Water SPA. A higher CL I (1.123) is set for Chichester & Langstone Harbours SPA
Airborne NOx	**30** µg/m^3	CL is set at 30 across all designated sites.
Airborne NH_3	**3** µg/m^3	Based on the absence of lichens and bryophytes as qualifying species of the potential SPA

Consideration of in-combination effects

The Solent and Dorset Coast potential SPA designated site is contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-19 compares the maximum modelled contribution of the Fareham 2023 Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All four pollutants exceeded the 1% screening threshold for the Fareham 2023 DM Scenario, and therefore likely significant effects from air quality impacts cannot be ruled out for any pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-19 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Grassland[a]	8*	4.78	59.7%
Acid deposition (kEq/ha-year)	Grassland[a]	0.626*	0.34	54.3%
Airborne NOx (µg/m^3)	n/a	30	10.1	33.8%
Airborne NH_3 (µg/m^3)	n/a	3*	0.88	29.2%

*Site not yet listed on APIS; for screening purposes, CLs are taken to be the lowest CLs from any nearby European-designated site.

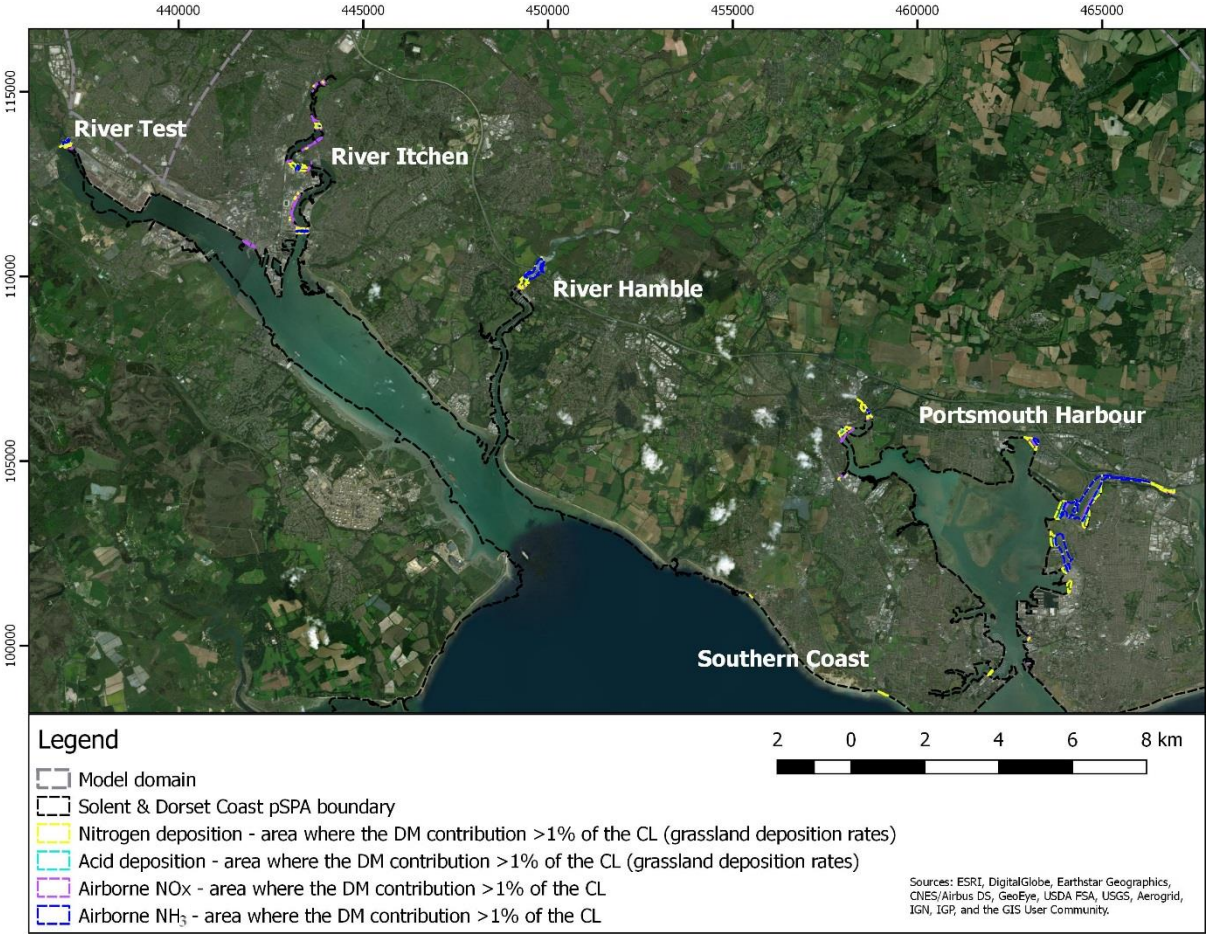
[a]This site is characterized by marine habitats with short vegetation, therefore grassland deposition rates are applicable.

3.6.3 HRA Stage 2: Appropriate Assessment

3.6.3.1 Assessment of areas

The following figure illustrates where the modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 1% of the CL for nitrogen and acid deposition, and airborne NOx and ammonia. The relevant CL assumed for Solent and Dorset Coast pSPA terrestrial habitats are listed in Table 3-18. Five areas of exceedance were identified. The appropriate assessment analysis has been undertaken using the nitrogen deposition screening results, as nitrogen deposition was predicted to have the largest area of impact.

Figure 3-29 Overview of screening results for airborne oxides of nitrogen (NOx), airborne ammonia (NH_3), nitrogen and acid deposition at Solent and Dorset Coast potential SPA, assuming grassland deposition rates

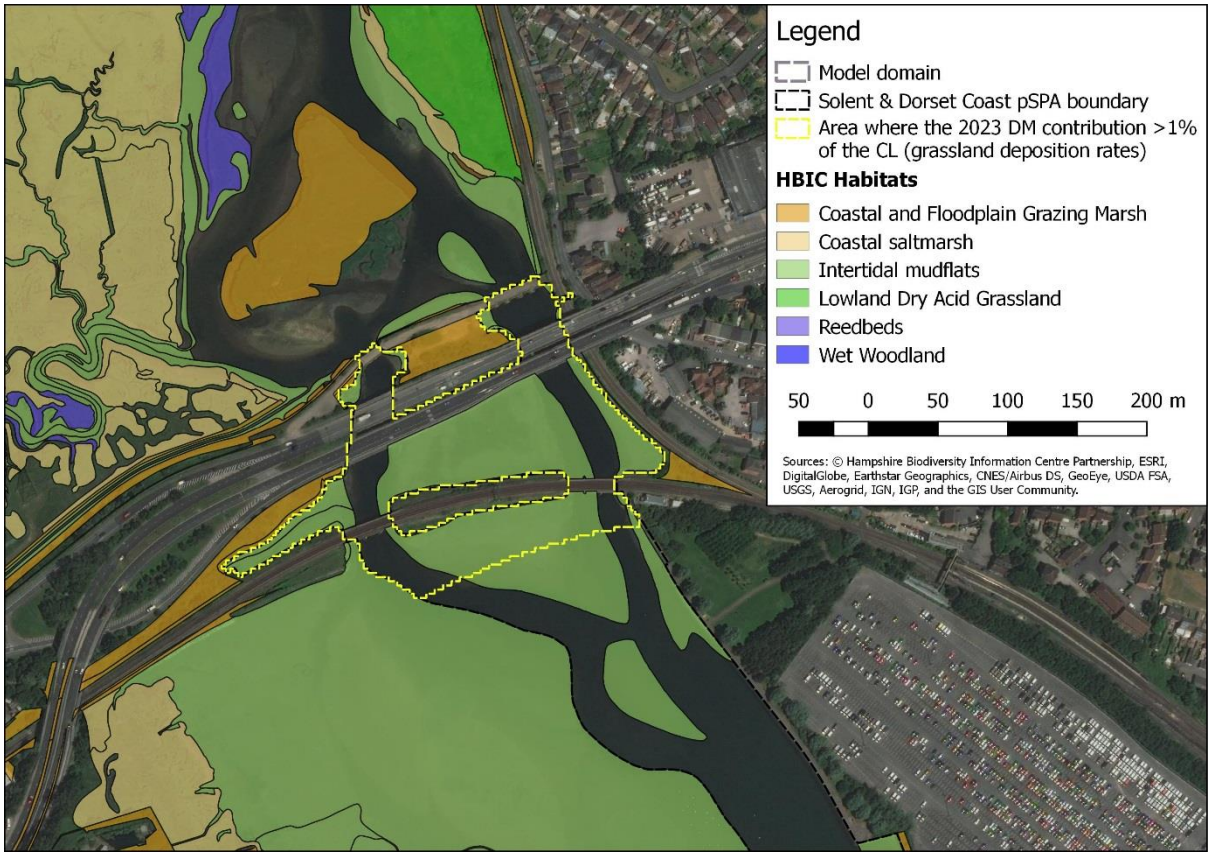


3.6.3.2 Area 1: River Test

The areas predicted to exceed the 1% screening threshold for nitrogen deposition (Figure 3-30) are entirely comprised of road surfaces, open water and intertidal mudflats, which would be regularly inundated with tidal water as supported by the Mean High Water mark.[42] This area was also predicted to exceed the screening thresholds for acid deposition, airborne NOx and airborne NH_3, however the areas exceeding the screening thresholds for those pollutants are smaller and contained within the larger area already considered for nitrogen deposition.

On the basis of available evidence, there are no adverse effects on this area of the Solent and Dorset Coast pSPA site arising from increased nitrogen deposition, acid deposition, airborne NOx or airborne NH_3 associated with the Fareham 2023 DM development scenario.

Figure 3-30 Areas where the modelled DM contribution of nitrogen deposition in 2023 exceeds 1% of the CL at the River Test / Redbridge / Totton Bypass in the Solent and Dorset Coast potential SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year

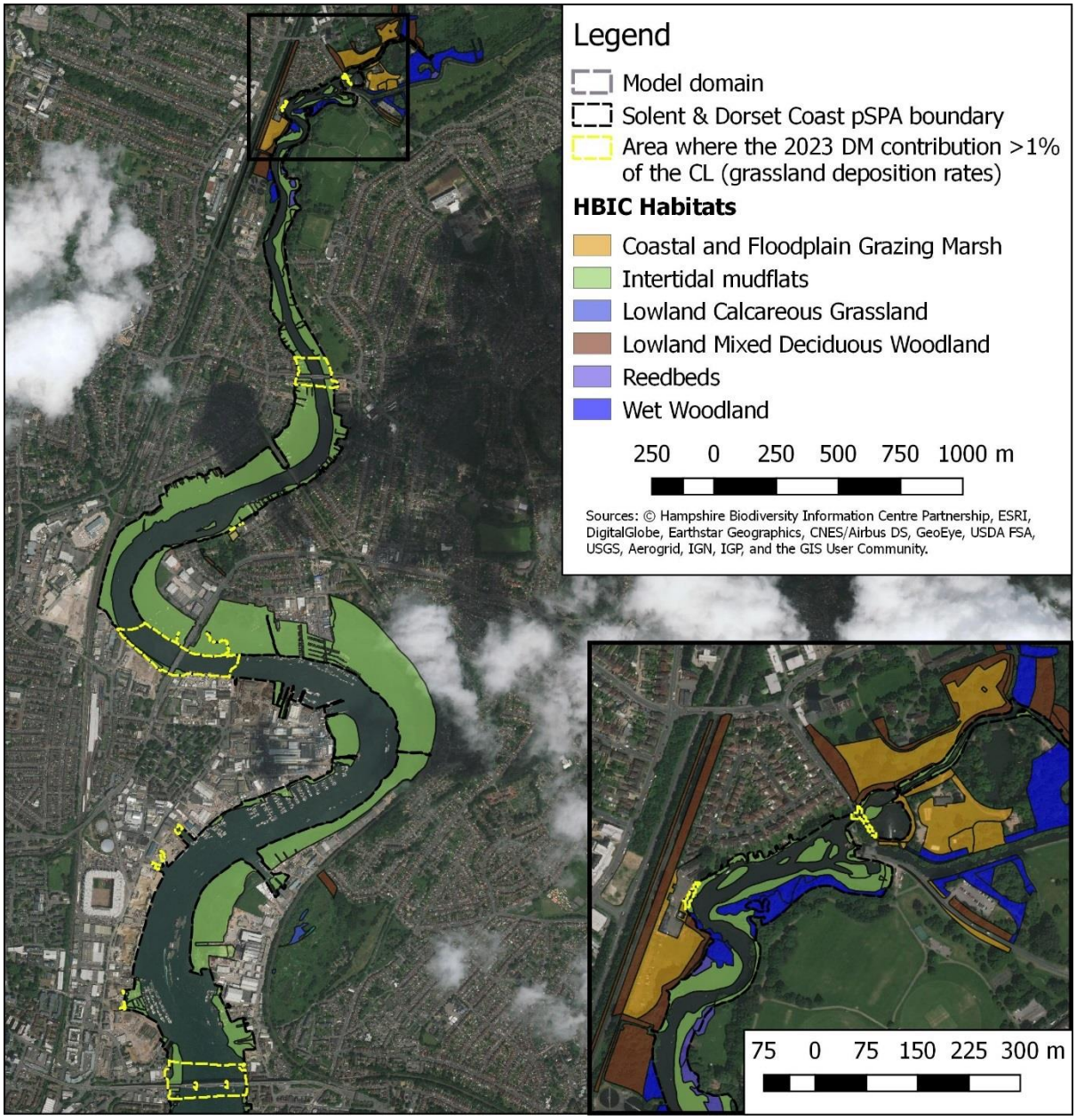


3.6.3.3 Area 2: River Itchen

The areas predicted to exceed the 1% screening threshold for nitrogen deposition (Figure 3-31) are entirely comprised of road surfaces, open water and intertidal mudflats, which would be regularly inundated with tidal water as supported by the Mean High Water mark.[42] This area was also predicted to exceed the screening thresholds for acid deposition, airborne NOx and airborne NH_3, however the areas exceeding the screening thresholds for those pollutants are smaller and contained within the larger area already considered for nitrogen deposition.

On the basis of available evidence, there are no adverse effects on this area of the Solent and Dorset Coast pSPA site arising from increased nitrogen deposition, acid deposition, airborne NOx or airborne NH_3 associated with the Fareham 2023 DM development scenario.

Figure 3-31 Areas where the modelled DM contribution of nitrogen deposition in 2023 exceeds 1% of the CL at the River Itchen in the Solent and Dorset Coast potential SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year

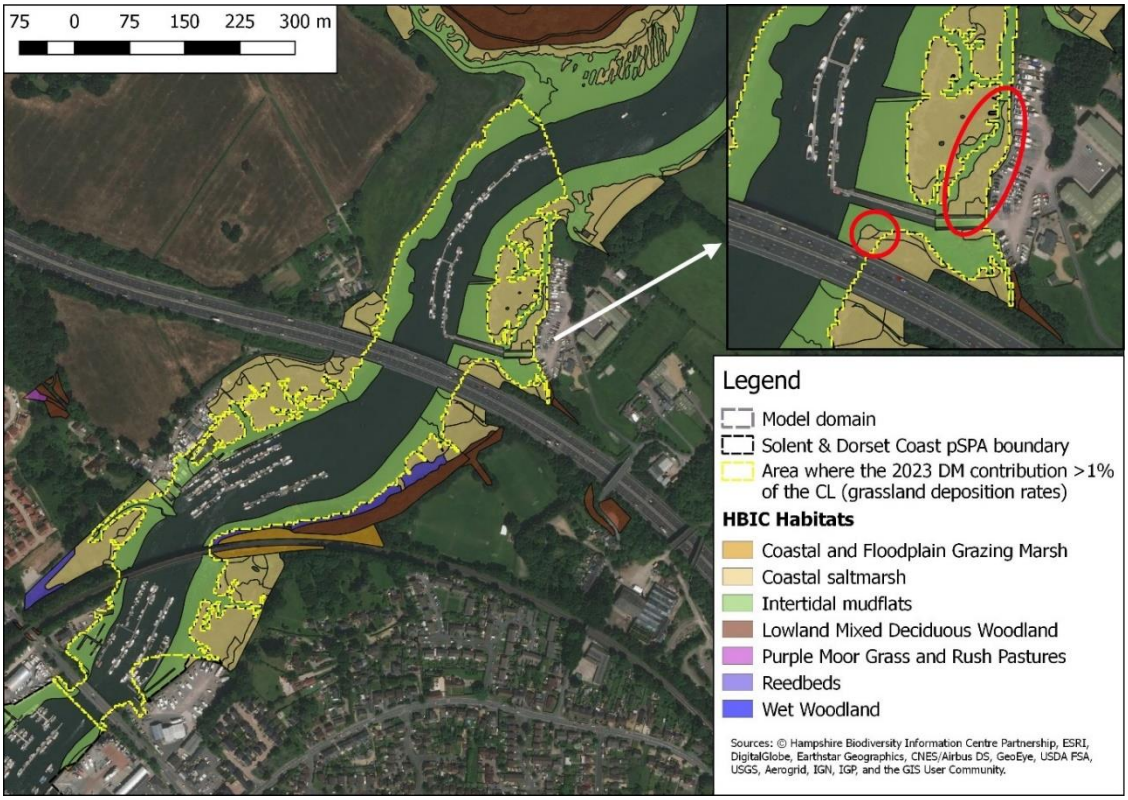


3.6.3.4 Area 3: Hamble River

Of the areas predicted to exceed the 1% screening threshold for nitrogen deposition (Figure 3-32), the majority consist of road surfaces, open water and intertidal mudflats, which would be regularly inundated with tidal water as supported by the Mean High Water mark.[42] There two small areas identified in the HBIC layer as coastal saltmarsh, circled in the above figure. These are also predicted to exceed the screening threshold for the other 3 pollutants (acid deposition, airborne NOx and NH_3), however upon further inspection these are also below the Mean High Water mark and so no significant effects arising from nitrogen deposition are expected.

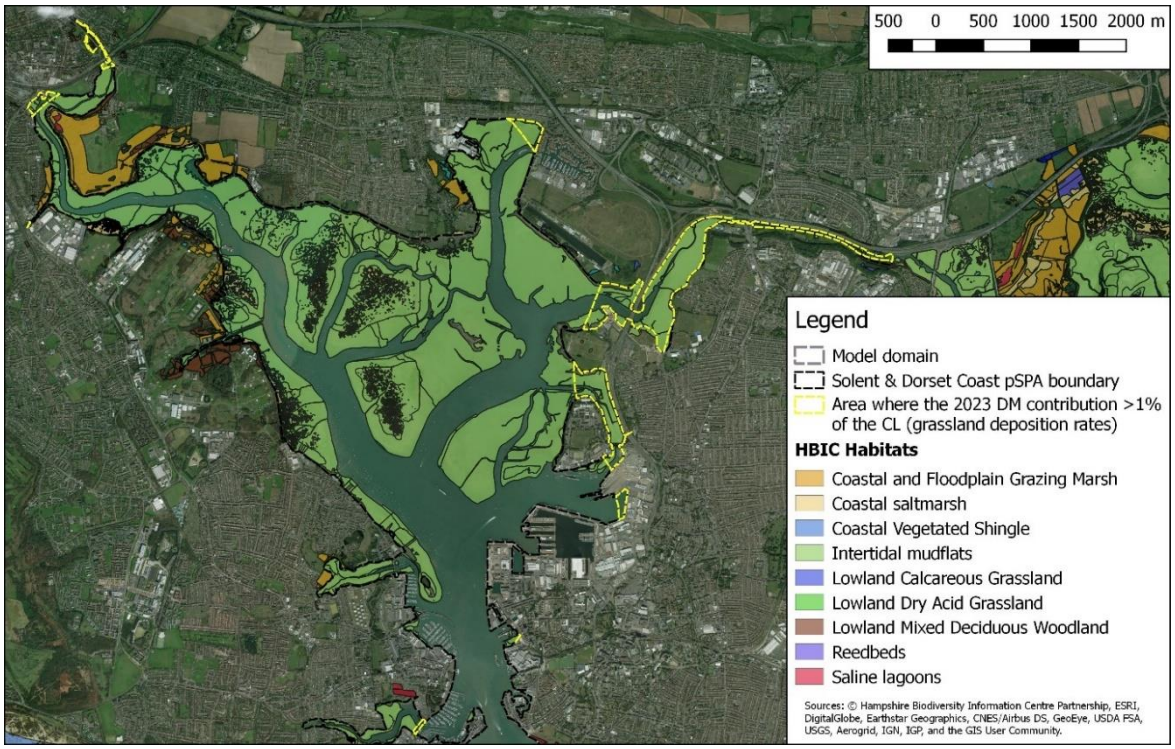
On the basis of available evidence, there are no adverse effects on this area of the Solent and Dorset Coast pSPA site arising from increased nitrogen deposition, acid deposition, airborne NOx or airborne NH3 associated with the Fareham 2023 DM development scenario.

Figure 3-32 Areas where the modelled DM contribution of nitrogen deposition in 2023 exceeds 1% of the CL at the River Hamble in the Solent and Dorset Coast potential SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year



3.6.3.5 Area 4: Portsmouth Harbour

Figure 3-33 Areas where the modelled DM contribution of nitrogen deposition in 2023 exceeds 1% of the CL at Portsmouth Harbour in the Solent and Dorset Coast potential SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year

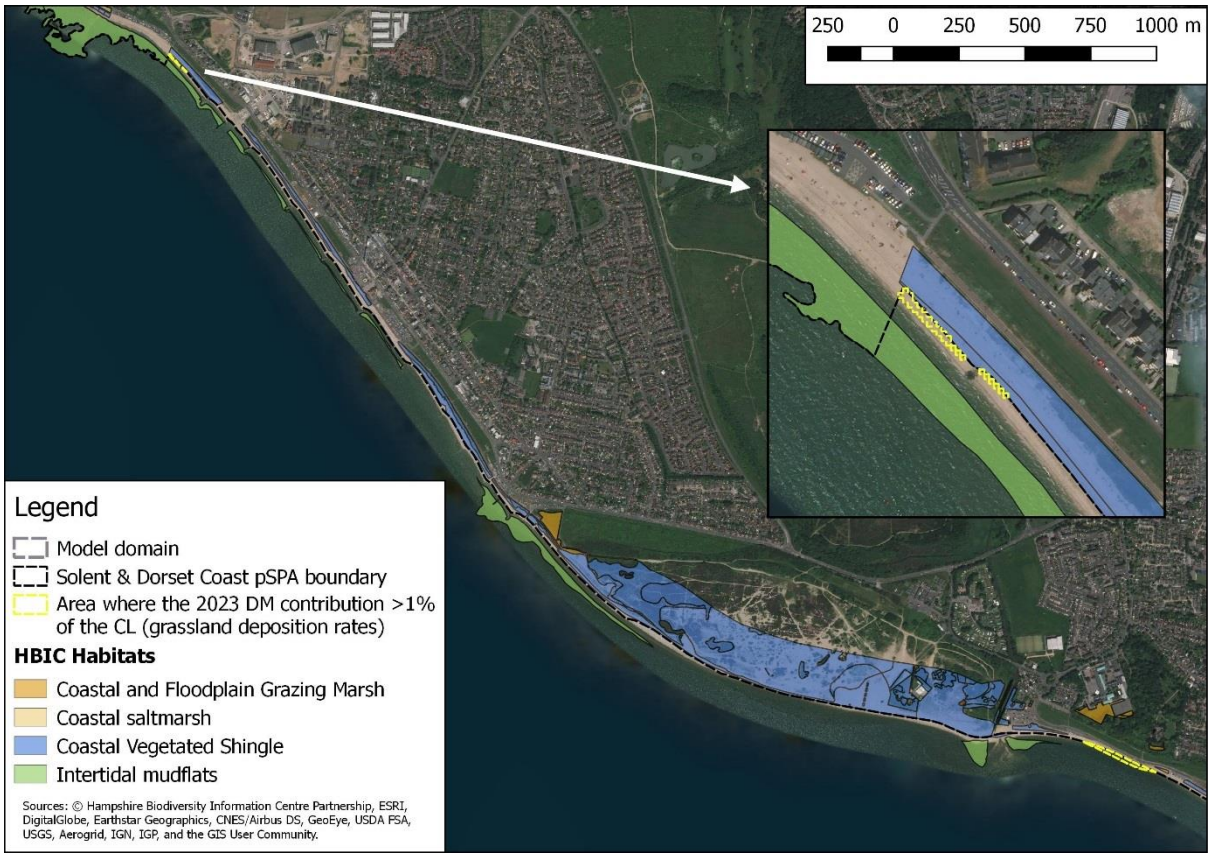


The areas predicted to exceed the 1% screening threshold for nitrogen deposition (Figure 3-33) are entirely comprised of road surfaces, open water and intertidal mudflats, which would be regularly inundated with tidal water as supported by the Mean High Water mark.[42] This area was also predicted to exceed the screening thresholds for acid deposition, airborne NOx and airborne NH3, however the areas exceeding the screening thresholds for those pollutants are smaller and contained within the larger area already considered for nitrogen deposition.

On the basis of available evidence, there are no adverse effects on this area of the Solent and Dorset Coast pSPA site arising from increased nitrogen deposition, acid deposition, airborne NOx or airborne NH3 associated with the Fareham 2023 DM development scenario.

3.6.3.6 Area 5: Southern Coast

Figure 3-34 Areas where the modelled DM contribution of nitrogen deposition in 2023 exceeds 1% of the CL on the Southern Coast in the Solent and Dorset Coast potential SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year



Both of these areas of exceedance occur along the shoreline, and the HBIC dataset does not contain any information about the priority habitats present. However, due to their proximity to the edge of the Solent they are likely to be regularly inundated with water; this is supported by the Mean High Water mark.[42]

As shown in Figure 3-35, this area is also predicted to exceed the screening threshold for airborne NOx, but total modelled NOx in the Fareham 2023 DM model scenario is predicted to be <30 µg/m^3.

On the basis of available evidence, there are no adverse effects on this area of the Solent and Dorset Coast pSPA site arising from increased nitrogen deposition, acid deposition, airborne NOx or airborne NH3 associated with the Fareham 2023 DM development scenario.

Figure 3-35 Overview of screening results and total modelled concentrations exceeding 30 µg/m³ for oxides of nitrogen (NOx) at Solent and Dorset Coast pSPA

3.6.3.7 Overall considerations

This potential SPA is designated for its tern species, with its predominant supporting feature being the sea surrounding their breeding colonies which forms a valuable plunge-diving foraging resource. As the site is predominantly designated for its marine foraging resource, there is very little in the way of terrestrial habitat within the designation boundary. The CLs on APIS, and used for preliminary analysis in the screening stage, are applicable to terrestrial habitat. The majority of the designated site boundary, and the majority of the area predicted to exceed the screening thresholds, is comprised of open water and intertidal mudflats which would be regularly inundated with tidal water as supported by the Mean High Water mark.[42] These areas have been individually discussed in the preceding sections, and it has been found that no adverse effects are anticipated as a result of the Fareham 2023 DM development scenario.

3.6.3.8 Assessment summary and conclusions

Adverse effects (pre-mitigation) can be discounted for all qualifying features of the Solent and Dorset Coast potential SPA, and for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

On the basis of available evidence, adverse effects on this potential SPA site can be discounted and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

3.7 Solent and Isle of Wight Lagoons SAC (UK0017073)

3.7.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Brading Marshes to St Helen's Ledges SSSI, Langstone Harbour SSSI, Hurst Castle & Lymington River Estuary SSSI, Gilkicker Lagoon SSSI.

Qualifying and notifiable features associated with this site include: **1150 Coastal lagoons.** The Solent on the south coast of England encompasses a series of Coastal lagoons, including percolation, isolated and sluiced lagoons. The site includes a number of lagoons in the marshes in the Keyhaven – Pennington area, at Farlington Marshes in Chichester Harbour, behind the sea-wall at Bembridge Harbour and at Gilkicker, near Gosport. The lagoons show a range of salinities and substrates, ranging from soft mud to muddy sand with a high proportion of shingle, which support a diverse fauna including large populations of three notable species: the nationally rare foxtail stonewort *Lamprothamnium papulosum*, the nationally scarce lagoon sand shrimp *Gammarus insensibilis*, and the nationally scarce starlet sea anemone *Nematostella vectensis*. The lagoons in Keyhaven – Pennington Marshes are part of a network of ditches and ponds within the saltmarsh behind a sea-wall. Farlington Marshes is an isolated lagoon in marsh pasture that, although separated from the sea by a sea-wall, receives sea water during spring tides. The lagoon holds a well-developed low-medium salinity insect-dominated fauna. Gilkicker Lagoon is a sluiced lagoon with marked seasonal salinity fluctuation and supports a high species diversity. The lagoons at Bembridge Harbour have formed in a depression behind the sea-wall and sea water enters by percolation. Species diversity in these lagoons is high and the fauna includes very high densities of *N. vectensis*.

The Site Improvement Plan (SIP 270) states that nitrogen deposition has been identified as a threat.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats,
- The structure and function (including typical species) of qualifying natural habitats, and
- The supporting processes on which qualifying natural habitats rely.

3.7.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-20 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-20 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Solent and Isle of Wight Lagoons

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Coastal lagoons	**20**	Not sensitive	**3***

* Not listed on APIS; value indicated by Natural England via email

Consideration of in-combination effects

The Solent and Isle of Wight Lagoons SAC designated site is contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and

2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-21 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

None of the pollutants exceeded the screening thresholds for the Fareham 2023 DM Scenario. On the basis of available evidence and agreed thresholds, likely significant effects associated with air pollution impacts as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region, can be discounted.

Table 3-21 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Grassland[a]	20	0.042	0.21%
Acid deposition (kEq/ha-year)	Grassland[a]	Not sensitive	0.0030	n/a
Airborne NOx (µg/m^3)	n/a	30	0.14	0.46%
Airborne NH_3 (µg/m^3)	n/a	3*	0.0056	0.19%

*APIS indicates that site specific advice should be sought. The site was screened using a CL of 3 µg/m^3 throughout the site, as indicated by Natural England via email.

[a]This site is characterized by marine habitats with short vegetation, therefore grassland deposition rates are applicable.

3.8 Solent and Southampton Water Ramsar (UK11063) and SPA (UK9011061)

3.8.1 Ramsar background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Brading Marshes to St. Helen's Ledges SSSI, Eling and Bury Marshes SSSI, Hurst Castle and Lymington River Estuary SSSI, Hythe to Calshot Marshes SSSI, King's Quay Shore SSSI, Lee-on-The-Solent to Itchen Estuary SSSI, Lincegrove and Hackett's Marshes SSSI, Lower Test Valley SSSI, Lymington River Reedbeds SSSI, Medina Estuary SSSI, Newtown Harbour SSSI, North Solent SSSI, Ryde Sands and Wootton Creek SSSI, Sowley Pond SSSI, Thorness Bay SSSI, Titchfield Haven SSSI, Upper Hamble Estuary and Woods SSSI, Whitecliff Bay and Bembridge Ledges SSSI and Yar Estuary SSSI.

Qualifying and notifiable features associated with this site include:

Ramsar Criterion 1: The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland and rocky boulder reefs.

Ramsar Criterion 2: The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight British Red Data Book plants are represented on site.

Ramsar Criterion 5: Assemblages of international importance:

Species with peak counts in winter:	
51343 waterfowl	(5 year peak mean 1998/99-2002/2003)

Ramsar Criterion 6: Species/populations occurring at levels of international importance.

Species with peak counts in spring/autumn:	
Ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa	397 individuals, representing an average of 1.2% of the GB population (5 year peak mean 1998/92002/3)
Species with peak counts in winter:	
Dark-bellied brent goose, *Branta bernicla bernicla*	6456 individuals, representing an average of 3% of the population (5 year peak mean 1998/92002/3)
Eurasian teal, *Anas crecca*, NW Europe	5514 individuals, representing an average of 1.3% of the population (5 year peak mean 1998/9-2002/3)
Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe	1240 individuals, representing an average of 3.5% of the population (5 year peak mean 1998/9-2002/3)

The Site Improvement Plan for the overlapping SPA (Solent SIP043) states that nitrogen deposition has been identified as a pressure. Ramsar sites do not have Site Improvement Plans.

Areas of Solent and Southampton Water (Ramsar & SPA) overlap with Solent Maritime (SAC).

3.8.2 SPA background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Brading Marshes to St. Helen's Ledges SSSI, Eling and Bury Marshes SSSI, Hurst Castle and Lymington River Estuary SSSI, Hythe to Calshot Marshes SSSI, King's Quay Shore SSSI, Lee-on-The-Solent to Itchen Estuary SSSI, Lincegrove and Hackett's Marshes SSSI, Lower Test Valley SSSI, Lymington River Reedbeds SSSI, Medina Estuary

SSSI, Newtown Harbour SSSI, North Solent SSSI, Ryde Sands and Wootton Creek SSSI, Sowley Pond SSSI, Thorness Bay SSSI, Titchfield Haven SSSI, Upper Hamble Estuary and Woods SSSI, Whitecliff Bay and Bembridge Ledges SSSI, Yar Estuary SSSI.

The site qualifies under **Article 4.1** of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season:	
Common Tern *Sterna hirundo*	267 pairs representing at least 2.2% of the breeding population in Great Britain (5 year peak mean, 1993-1997)
Little Tern *Sterna albifrons*	49 pairs representing at least 2.0% of the breeding population in Great Britain (5 year peak mean, 1993-1997)
Mediterranean Gull *Larus melanocephalus*	2 pairs representing at least 20.0% of the breeding population in Great Britain (5 year peak mean, 1994-1998)
Roseate Tern *Sterna dougallii*	2 pairs representing at least 3.3% of the breeding population in Great Britain (5 year peak mean, 1993-1997)
Sandwich Tern *Sterna sandvicensis*	231 pairs representing at least 1.7% of the breeding population in Great Britain (5 year peak mean, 1993-1997)

The site also qualifies under **Article 4.2** of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Over winter:	
Black-tailed Godwit *Limosa limosa* islandica	1,125 individuals representing at least 1.6% of the wintering Iceland - breeding population (5 year peak mean, 1992/3-1996/7)
Dark-bellied Brent Goose *Branta bernicla bernicla*	7,506 individuals representing at least 2.5% of the wintering Western Siberia/Western Europe population (5 year peak mean, 1992/3-1996/7)
Ringed Plover *Charadrius hiaticula*	552 individuals representing at least 1.1% of the wintering Europe/Northern Africa - wintering population (5 year peak mean, 1992/3-1996/7)
Teal *Anas crecca*	4,400 individuals representing at least 1.1% of the wintering Northwestern Europe population (5 year peak mean, 1992/3-1996/7)

Assemblage qualification: A wetland of international importance. The area qualifies under **Article 4.2** of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl.

Over winter, the area regularly supports 53,948 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Gadwall *Anas strepera*, Teal *Anas crecca,* Ringed Plover *Charadrius hiaticula*, Black-tailed Godwit *Limosa limosa islandica*, Little Grebe *Tachybaptus ruficollis*, Great Crested Grebe *Podiceps cristatus*, Cormorant *Phalacrocorax carbo*, Dark-bellied Brent Goose *Branta bernicla bernicla*, Wigeon *Anas penelope*, Redshank *Tringa totanus*, Pintail *Anas acuta*, Shoveler *Anas clypeata*, Red-breasted Merganser *Mergus serrator*, Grey Plover *Pluvialis squatarola*, Lapwing *Vanellus vanellus*, Dunlin *Calidris alpina alpina*, Curlew *Numenius arquata*, Shelduck *Tadorna tadorna*.

The Site Improvement Plan for the SPA (Solent SIP043) states that nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

Areas of Solent and Southampton Water (Ramsar & SPA) overlap with Solent Maritime (SAC).

3.8.3 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-22 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-22 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Solent and Southampton Water Ramsar and SPA

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs (µg/m^3)
Sterna sandvicensis (Western Europe/Western Africa) - Sandwich tern	**8**	**0.626**	**3**
Sterna dougallii (Europe - breeding) - Roseate tern	**8**	**0.626**	**3**
Sterna hirundo (Northern/Eastern Europe - breeding) - Common tern	**8**	**0.626**	**3**
Sterna albifrons (Eastern Atlantic - breeding) - Little tern	8	**0.626**	**3**
Branta bernicla bernicla (Western Siberia/Western Europe) - Dark-bellied brent goose	20	Not sensitive	**3**
Anas crecca (North-western Europe) - Eurasian teal	20	Not sensitive	**3**
Charadrius hiaticula (Europe/Northern Africa - wintering) - Ringed plover	20	Not sensitive	**3**
Limosa limosa islandica (Iceland - breeding) - Black-tailed godwit	20	Not sensitive	**3**
Larus melanocephalus - Mediterranean gull	20	Not sensitive	**3**

Consideration of in-combination effects

The Solent and Southampton Water Ramsar and SPA designated sites are contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-23 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All pollutants are predicted to exceed the 1% screening threshold for the Fareham 2023 DM Scenario, and therefore likely significant effects from air quality impacts cannot be ruled out for any pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-23 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Grassland[a]	8	0.76	9.5%
Acid deposition (kEq/ha-year)	Grassland[a]	0.626	0.054	8.6%
Airborne NOx (µg/m^3)	n/a	30	3.98	13.3%
Airborne NH_3 (µg/m^3)	n/a	3	0.092	3.1%

[a] Although there are isolated pockets of trees within the SAC boundary, these are not associated with the qualifying and notifiable features of the designated site. The rest of the site is mainly characterized by marine habitats with short vegetation, and in these areas, the grassland deposition rates are applicable.

3.8.4 HRA Stage 2: Appropriate Assessment

3.8.4.1 Airborne NH_3

The relevant CL for Solent and Southampton Water Ramsar and SPA is 3 µg/m^3 for all features.

The following figure illustrates the areas where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.03 µg/m^3 (1% of 3 µg/m^3). Three areas of exceedance were identified: the Redbridge Causeway in the West, the A3024 at Bitterne, and an area of the River Hamble near Swanwick.

Figure 3-36 Overview of screening results for airborne ammonia at Solent and Southampton Water Ramsar & SPA, assuming a CL of 3 µg/m^3

Figure 3-37 and Figure 3-38 show the total modelled concentrations of airborne ammonia at the areas of exceedance of 1% of the CL.

Figure 3-37 Total modelled concentrations of airborne ammonia at Redbridge Causeway and the A3024 at Bitterne, Solent and Southampton Water Ramsar & SPA in 2023, assuming a CL of 3 µg/m^3

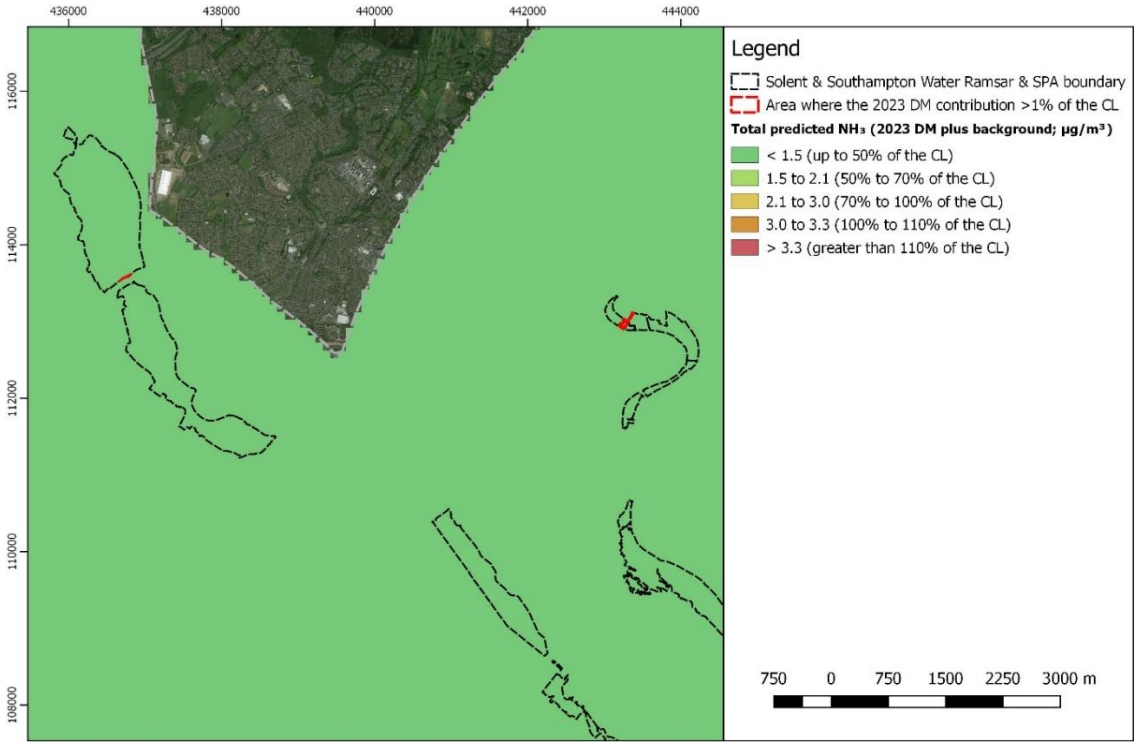
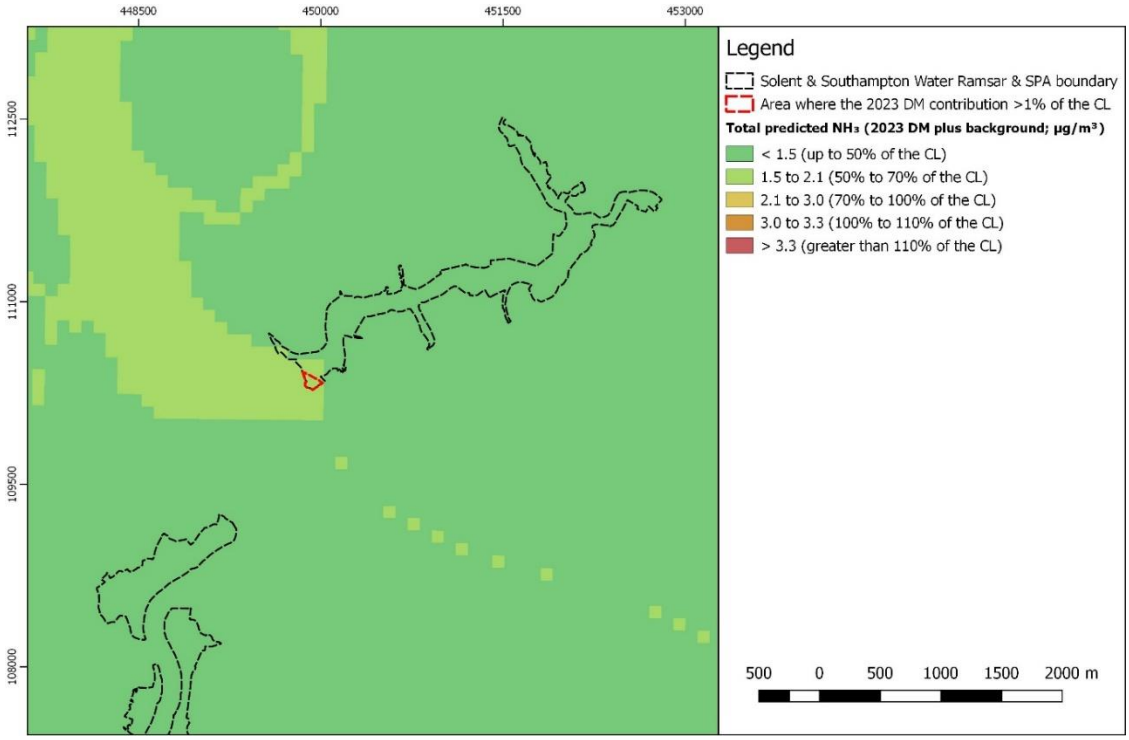


Figure 3-38 Total modelled concentrations of airborne ammonia at the River Hamble near Swanwick, Solent and Southampton Water Ramsar & SPA in 2023, assuming a CL of 3 µg/m³



The maximum total modelled contribution from the Fareham 2023 DM scenario was 1.82 µg/m³, which represents 60.7% of the CL and as such a likely significant effect as a result of airborne ammonia can be discounted.

On the basis of available evidence, there are no adverse effects on this Ramsar and SPA site arising from increased NH_3 associated with the Fareham 2023 DM development scenario

3.8.4.2 Other pollutants

Due to the size of the Solent & Southampton Water site, the analysis for acid deposition, nitrogen deposition and NOx have been organized by geographical location, followed by consideration for each pollutant at that location. The following figure shows the geographical area of analysis.

Summary of critical loads for nitrogen deposition:

The lowest Critical Loads are listed for potential impacts to four species of tern (Sandwich tern, Roseate tern, Common tern and Little tern) due to impacts on the broad habitat used for reproducing (Supralittoral sediment – acidic type).

- 8 – 10 kgN/ha-year if found on Coastal stable dune grasslands (acid type)
- 10 – 15 kgN/ha-year if found on Coastal stable dune grasslands (calcareous type)
- 10 – 20 kgN/ha-year if found on Shifting coastal dunes

The higher CL of 20 – 30 kgN/ha-year applies for other birds and their associated habitats, such as Eurasian teal (broad habitat type – pioneer, low-mid, mid-upper saltmarshes).

Figure 3-39 illustrates the areas where the nitrogen deposition modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL). Four areas of exceedance were identified: Redbridge, Northam, Lower Swanwick and Lee-on-the-Solent.

Figure 3-39 Overview of screening results for nitrogen deposition at Solent and Southampton Water Ramsar & SPA, assuming grassland deposition rates and a CL of 8 kgN/ha-year

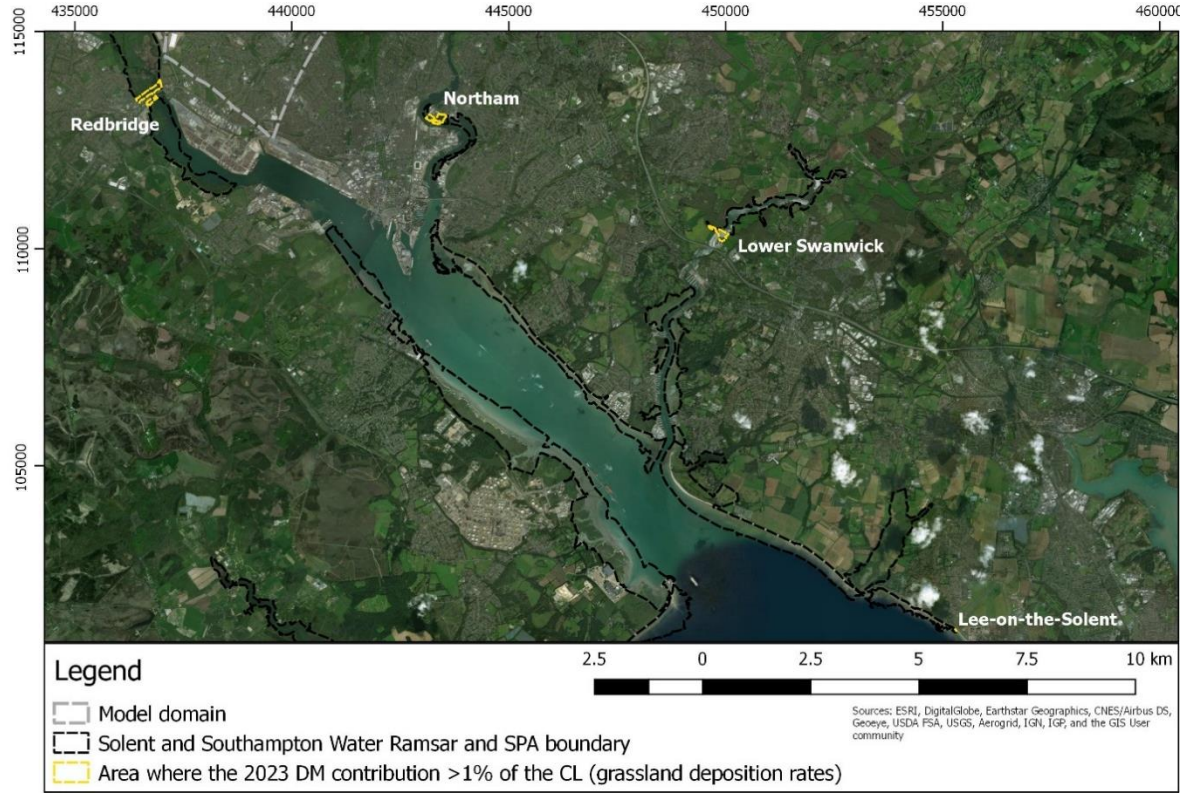
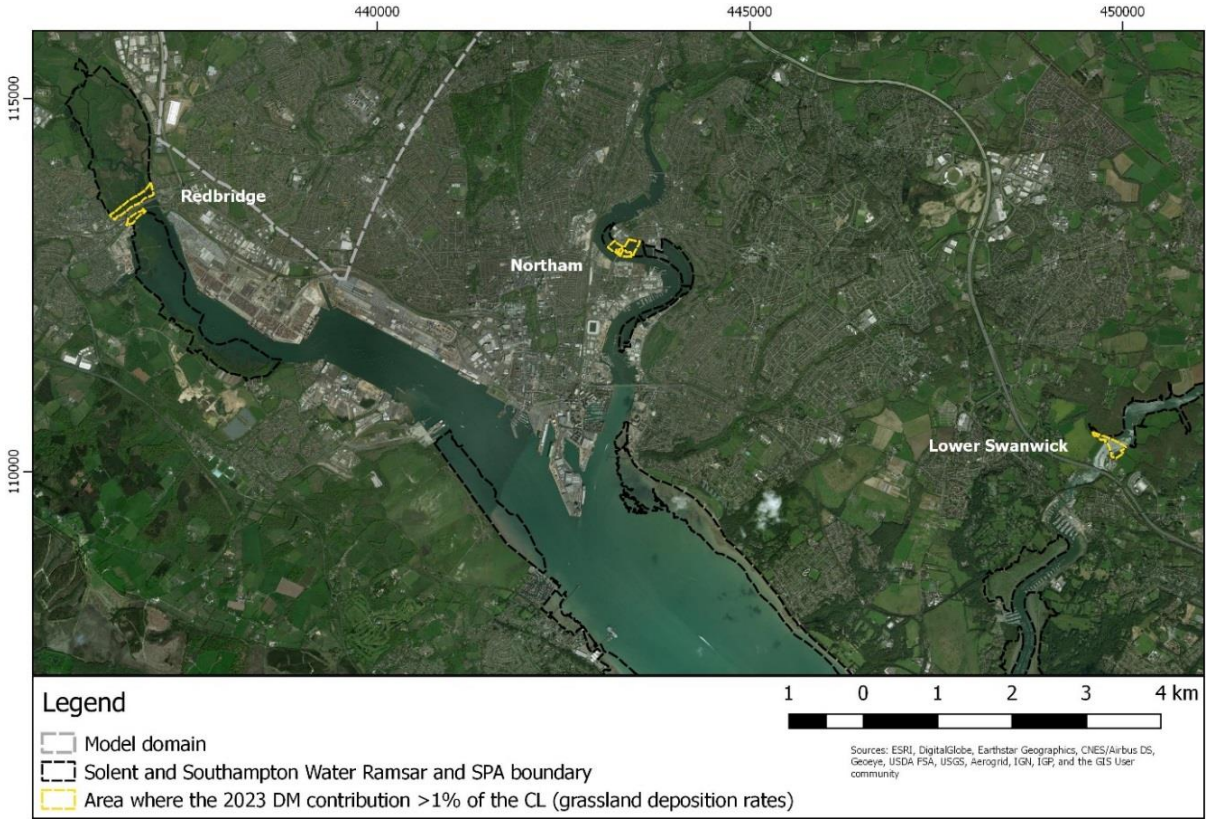


Figure 3-40 Overview of screening results for acid deposition at Solent and Southampton Water Ramsar & SPA, assuming grassland deposition rates and a CL of 0.626 kEq/ha-year



Summary of critical loads for acid deposition:

The lowest CLs are set for the four species of tern (Sandwich tern, Roseate tern, Common tern and Little tern) for the broad habitat used for reproducing (Supralittoral sediment – acidic type; acid grassland, MinCLMaxN = 0.626 kEq/ha-year). For the same tern species in the broad habitat Supralittoral sediment – calcareous type, a higher CL is set (calcareous grassland, MinCLMaxN = 4.856 kEq/ha-year). The Common tern is the only feature listed on APIS as having "Potential negative impact on species due to impacts on the species' broad habitat"; the other three tern species are listed as having "No expected negative impact on the species due to impacts on the species' broad habitat".

No CLs are listed on APIS for the broad habitats of the Eurasian teal, Ringed plover, Mediterranean gull, Dark-bellied brent goose or Black-tailed godwit.

Figure 3-40 illustrates the areas where the acid deposition modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.00626 kgN/ha-year (1% of the lowest CL). Three of the four areas of exceedance are identified as similar to those for nitrogen deposition: Redbridge, Northam and Lower Swanwick.

Summary of critical loads for airborne NOx:
The relevant CL for airborne NOx at Solent and Southampton Water Ramsar and SPA is 30 µg/m^3 for all vegetation.

3.8.4.2.1 Area 1: Northam

3.8.4.2.1.1 Nitrogen deposition

Figure 3-41 illustrates the Northam area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

The background level for nitrogen deposition in this area of the Solent & Southampton Water site[64] is 17.22 kgN/ha-year, so the lowest CL for the habitats of the four tern species is already exceeded. The total predicted nitrogen deposition rate is less than 20 kgN/ha-year and does not exceed the CL set for other birds and their habitats (20 to 30 kgN/ha-year).

According to the HBIC dataset and satellite imagery, the areas predicted to exceed the screening threshold for nitrogen deposition correspond to intertidal mudflats, which would be regularly inundated with tidal water. It does not appear that there is any suitable breeding habitat for terns within this area, and adverse effects from nitrogen deposition are considered unlikely. Natural England have also confirmed that breeding terns are unlikely to be found in this area of exceedance.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

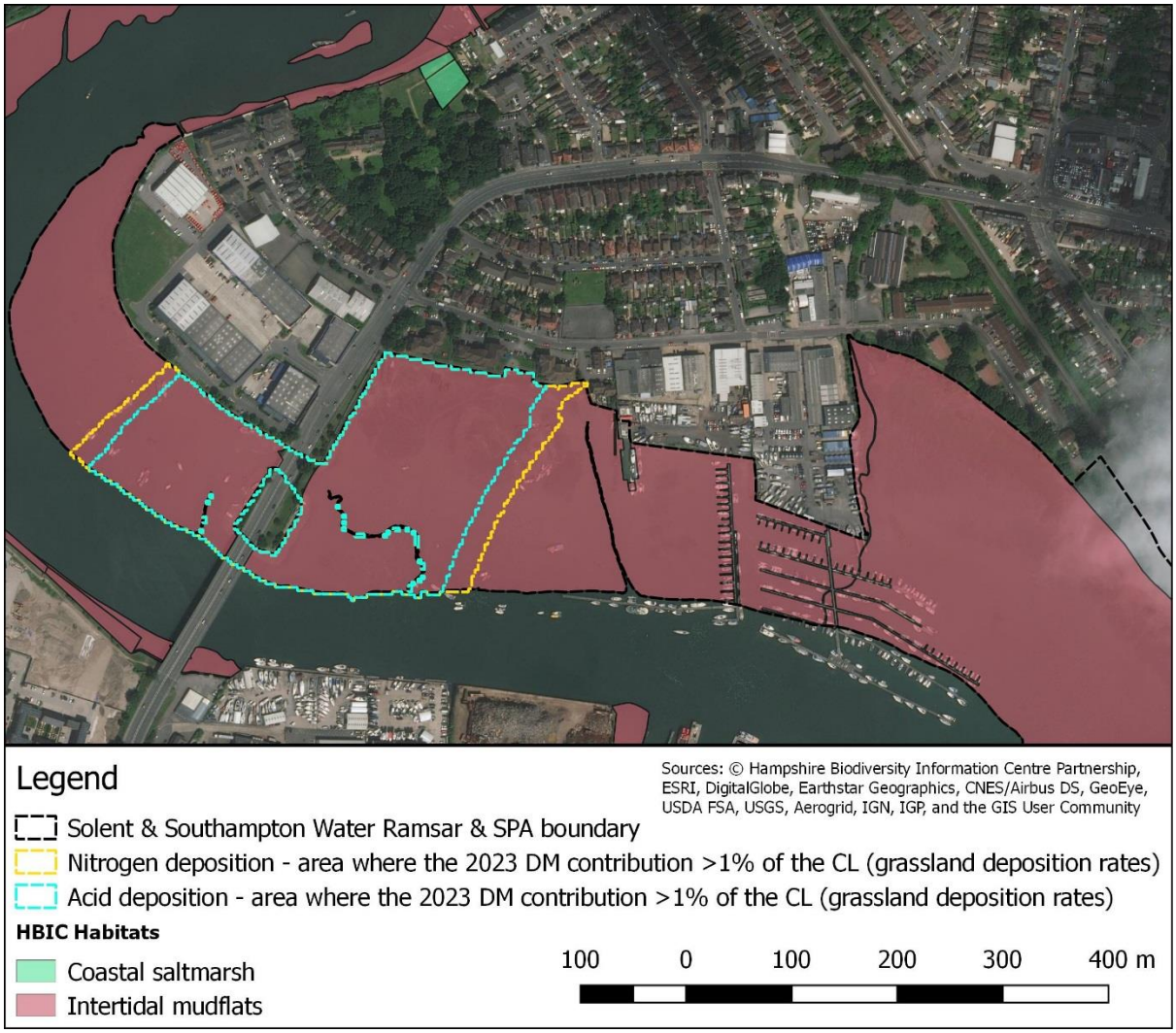
3.8.4.2.1.2 Acid deposition

The areas predicted to exceed the screening threshold for acid deposition are smaller than the areas predicted to exceed the screening threshold for nitrogen deposition (Figure 3-41), which were discussed in the previous section and correspond to intertidal mudflats. The same conclusions from Section 3.8.4.2.1.1 apply for acid deposition.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

[64] Site/Feature Information, Solent and Southampton Water, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK9011061&deptype=M&featurecode=A137&accode=CG4, accessed 16/08/2019.

Figure 3-41 Areas where the modelled DM contribution of nitrogen deposition and acid deposition exceed 1% of the CL assuming grassland deposition rates and CLs of 8 kgN/ha-year and 0.626 kEq/ha-year respectively, at Solent and Southampton Water Ramsar & SPA: Northam



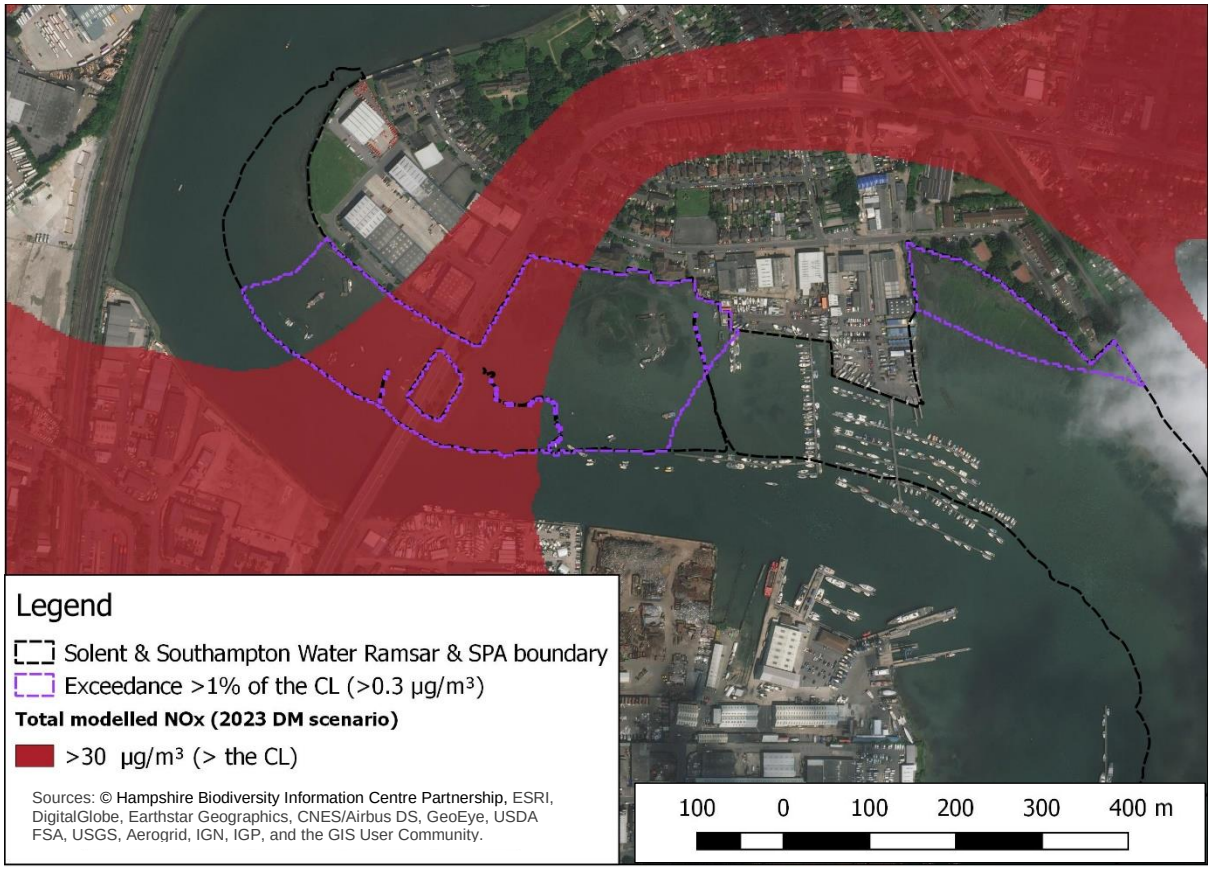
3.8.4.2.1.3 Airborne NOx

Figure 3-42 illustrates the Northam area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas in Northam which overlap with the red portions of the map, where total predicted concentrations in 2023 are >30 µg/m^3, are classified as intertidal mudflats. Intertidal mudflats are regularly inundated by tidal waters, supported by the Mean High Water mark[42] and air pollution impacts are not expected to be significant.

Due to the intertidal nature of the area, there are no adverse effects on this part of the Ramsar and SPA site arising from increased airborne NOx concentrations associated with the Fareham 2023 DM development scenario.

Figure 3-42 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m³ for oxides of nitrogen (NOx) at Solent and Southampton Water Ramsar & SPA: Northam



3.8.4.2.2 Area 2: Lower Swanwick / M27

3.8.4.2.2.1 Nitrogen deposition

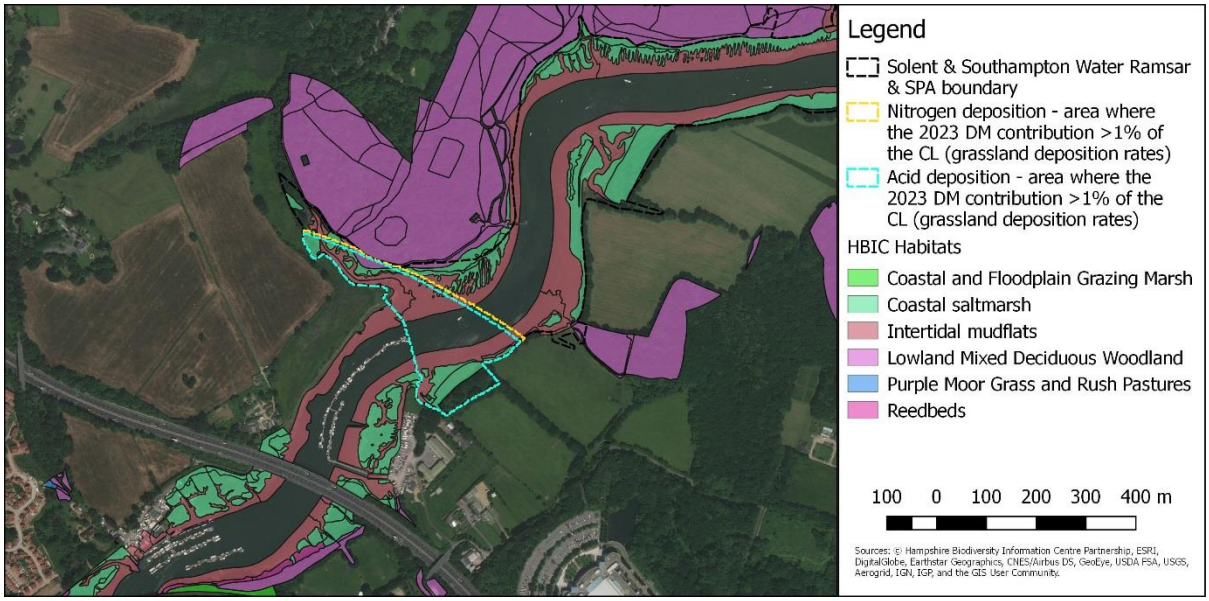
Figure 3-43 illustrates the Lower Swanwick area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

The background levels for nitrogen deposition in this area of Solent & Southampton Water site[64] is 19.04 kgN/ha-year, so the lowest CL for the habitats of the four tern species is already exceeded. The model results predict that the highest contribution from the Fareham 2023 DM scenario in this area of the site is 0.32 kgN/ha-year, occurring at the southernmost point of the area predicted to exceed the screening thresholds. The worst-case total predicted deposition rate, assuming a background deposition rate of 19.04 kgN/ha-year and a Fareham 2023 DM contribution of 0.32 kgN/ha-year, is 19.36 kgN/ha-year. This is below the CL range set for species of birds other than terns.

The areas predicted to exceed the screening threshold for nitrogen deposition are classified in the HBIC dataset as a mixture of: coastal saltmarsh, intertidal mudflat and lowland mixed deciduous woodland. It does not appear that there is any suitable breeding habitat for terns within this area. Natural England have also confirmed that breeding terns are unlikely to be found in this area of exceedance.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

Figure 3-43 Areas where the modelled DM contribution of nitrogen and acid deposition exceed 1% of the CL, assuming grassland deposition rates and a CLs of of 8 kgN/ha-year and 0.626 kEq/ha-year, respectively, at Solent and Southampton Water Ramsar & SPA: Lower Swanwick/M27



3.8.4.2.2.2 Acid deposition

Figure 3-43 also illustrates the areas where modelled contributions from the 2023 Fareham DM scenario are predicted to exceed 0.00626 kEq/ha-year (1% of the lowest CL).

The areas predicted to exceed the screening threshold for acid deposition are smaller than the areas predicted to exceed the screening threshold for nitrogen deposition, which were discussed in the previous section. The same conclusions from Section 3.8.4.2.2.1 apply for acid deposition.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

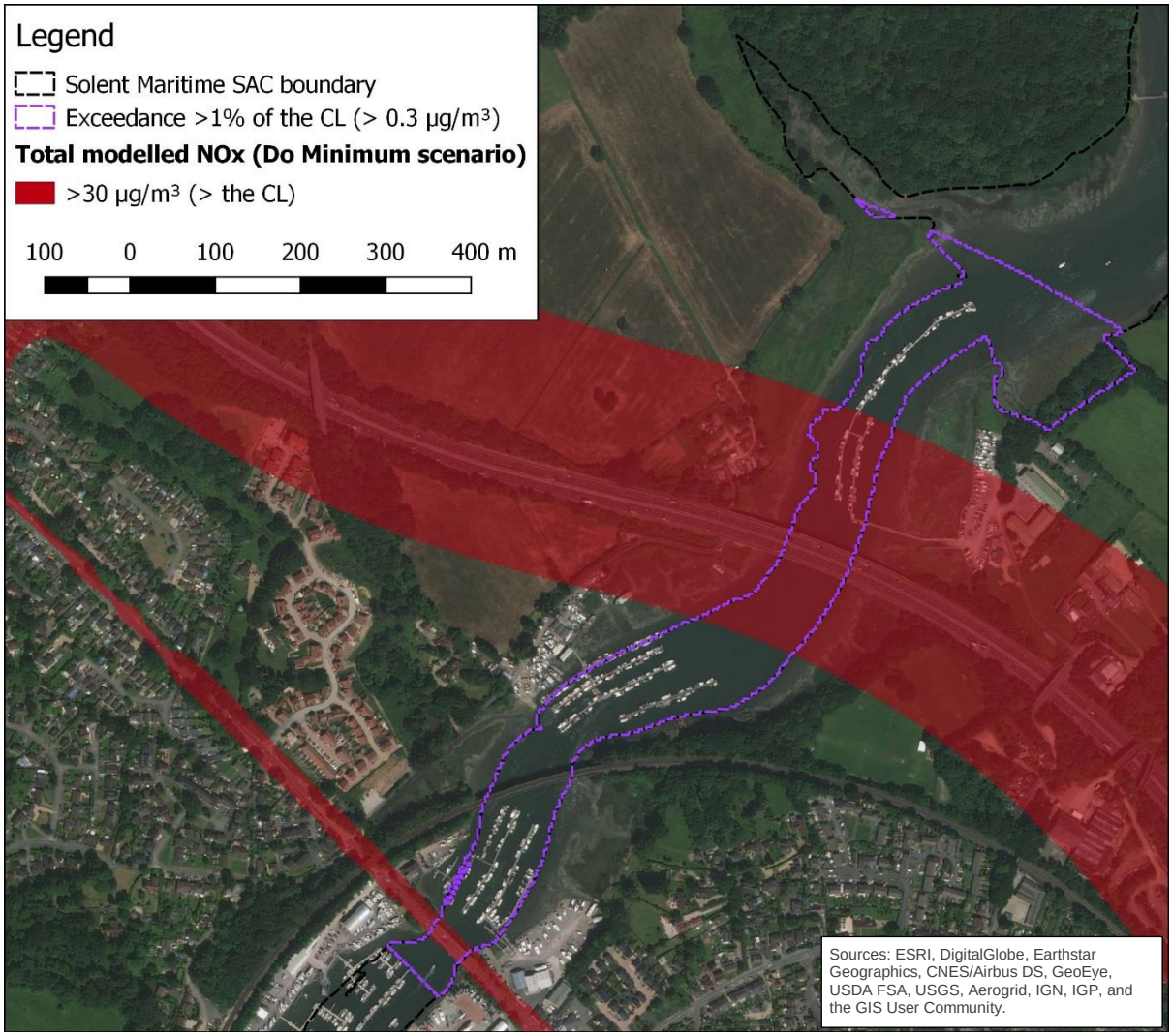
3.8.4.2.2.3 Airborne NOx

Figure 3-44 illustrates the Lower Swanwick area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas of Lower Swanwick which are predicted to exceed both 30 µg/m^3 total modelled concentration and 1% of the CL in 2023, align with road surfaces (the M27 and the A27) and areas of the River Hamble covered by water. Air pollution impacts are not expected to be significant.

Due to the absence of sensitive features in these exceeding areas, there are no adverse effects on this part of the Ramsar and SPA site arising from increased airborne NOx concentrations associated with the Fareham 2023 DM development scenario.

Figure 3-44 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m³ for oxides of nitrogen (NOx) at Solent and Southampton Water Ramsar & SPA: Lower Swanwick/M27



3.8.4.2.3 Area 3: Redbridge / Totton Bypass

3.8.4.2.3.1 Nitrogen deposition

Figure 3-45 illustrates the Redbridge area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

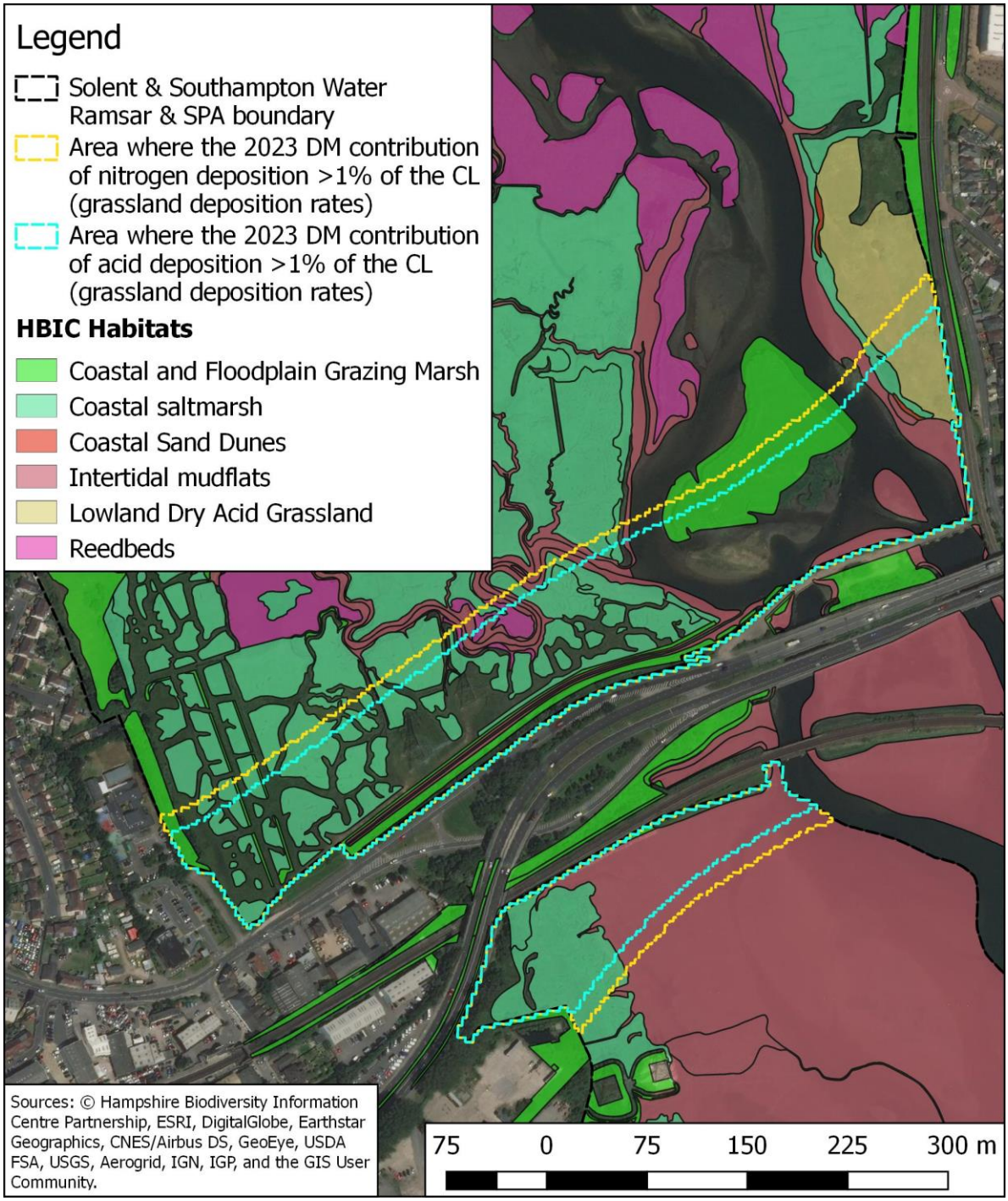
For those areas predicted to exceed the 1% screening threshold (with a CL of 8 kgN/ha-year), APIS indicates that the current background nitrogen deposition[64] is 15.96 kgN/ha-year. The model results predict that the highest contribution from the Fareham 2023 DM scenario in this area of the Solent Maritime SAC is 0.35 kgN/ha-year, occurring immediately north of the Redbridge Causeway road surface. The worst-case total predicted deposition rate, assuming a background deposition rate of 15.96 kgN/ha-year and a Fareham 2023 DM contribution of 0.35 kgN/ha-year, is 16.31 kgN/ha-year. This is below 20 kgN/ha-year, and based on this analysis, we can conclude that there will not be an adverse effect on areas of the designated site where a CL of 20 kgN/ha-year is applicable.

The areas predicted to exceed the screening threshold for nitrogen deposition are classified in the HBIC dataset as a mixture of: coastal and floodplain grazing marsh, coastal saltmarsh, coastal sand dunes, intertidal mudflat, lowland dry acid grassland and reedbeds. It does not appear that there is any suitable

breeding habitat for terns within this area. Natural England have also confirmed that breeding terns are unlikely to be found in this area of exceedance.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

Figure 3-45 Areas where the modelled DM contribution of nitrogen deposition and acid deposition exceed 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year and 0.626 kEq/ha-year, respectively, at Solent and Southampton Water Ramsar & SPA: Redbridge/Totton Bypass



3.8.4.2.3.2 Acid deposition

Figure 3-45 also illustrates the Redbridge area where the modelled contributions to acid deposition from the Fareham 2023 DM scenario are predicted to exceed 0.00626 kEq/ha-year (1% of the lowest CL).

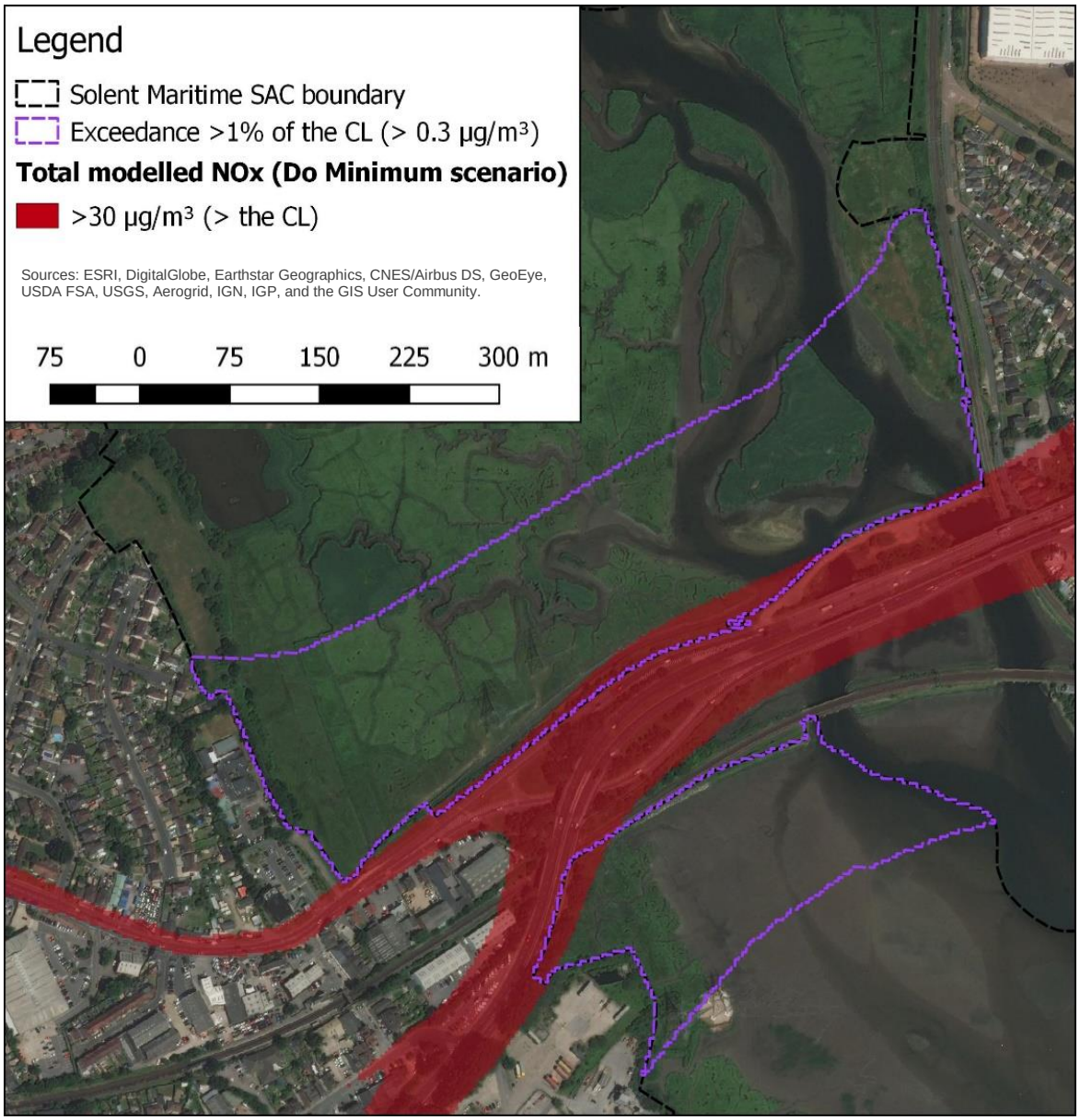
The areas predicted to exceed the screening threshold for acid deposition are smaller than those predicted to exceed for nitrogen deposition. The same conclusions from Section 3.8.4.2.3.1 apply.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

3.8.4.2.3.3 Airborne NOx

Figure 3-46 illustrates the Redbridge area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

Figure 3-46 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m^3 for oxides of nitrogen (NOx) at Solent and Southampton Water Ramsar & SPA: Redbridge/Totton Bypass



The areas in Redbridge / Totton Bypass which overlap with the red portions of the map, where total predicted concentrations in 2023 exceed 30 µg/m^3, extend up to approximately 30 m north and south from sections of the Bypass road surface. The areas predicted to experience total concentrations greater than 30 µg/m^3 are classified in the HBIC dataset as a mixture of: coastal and floodplain grazing marsh, Intertidal mudflat and coastal saltmarsh. It does not appear that there is any suitable breeding habitat for terns within this area and Natural England have confirmed that breeding terns are unlikely to be found in this area of exceedance.[40] In addition, ecological expertise has not been able to identify a pathway by which breeding terns could be affected by airborne pollution. The same conclusions from Section 3.8.4.2.3.1 apply.

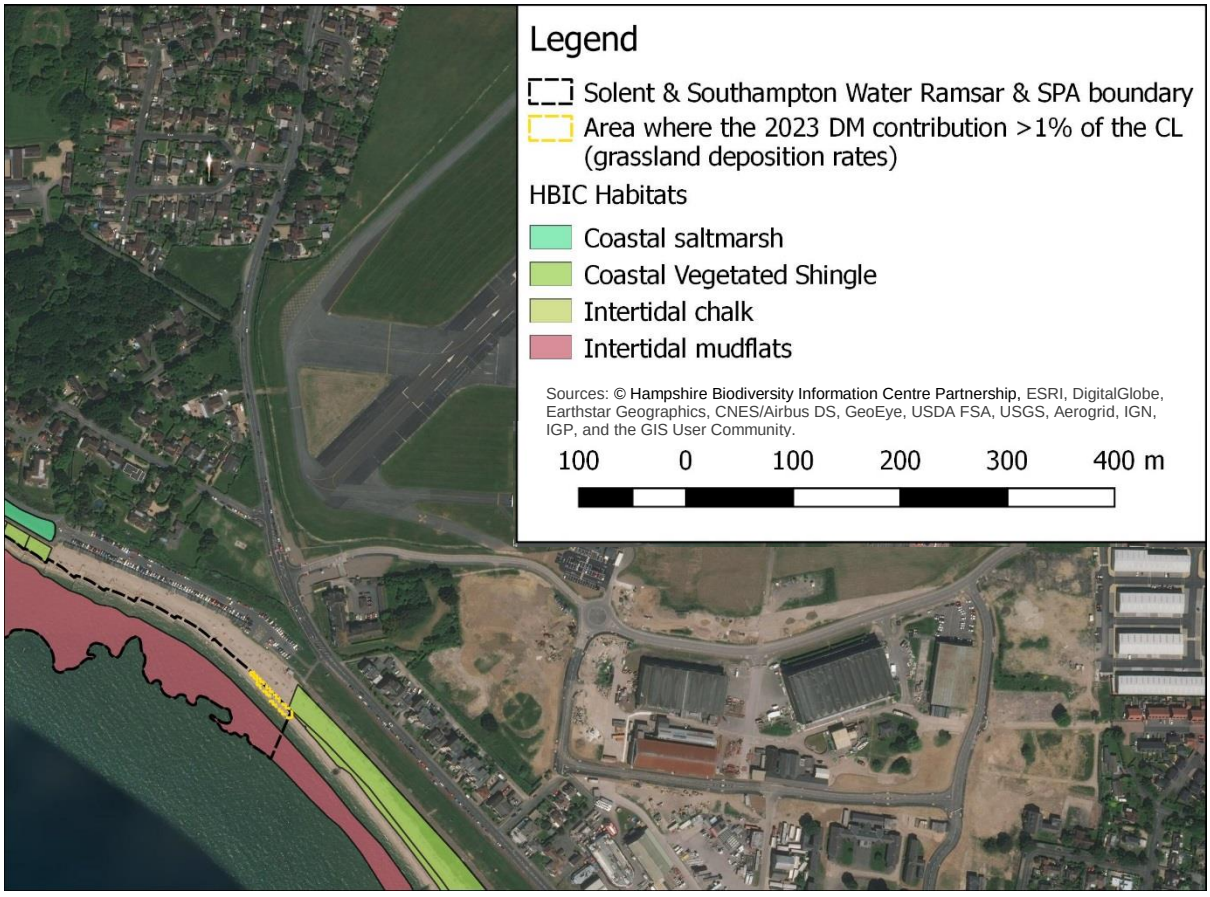
On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased NOx associated with the Fareham 2023 DM development scenario.

3.8.4.2.4 Area 4: Lee-on-the-Solent

3.8.4.2.4.1 Nitrogen deposition

Figure 3-47 illustrates the Redbridge area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

Figure 3-47 Areas where the modelled DM contribution of nitrogen deposition exceeds 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year, at Solent and Southampton Water Ramsar & SPA: Lee-on-the-Solent



The background levels for nitrogen deposition range in this area of the Solent & Southampton Water site[64] is 14 kgN/ha-year, so the lowest CL for the habitats of the four tern species are already exceeded. The total predicted nitrogen deposition rate is less than 20 kgN/ha-year and does not exceed the CL set for other birds and their habitats (20 to 30 kgN/ha-year).

According to satellite imagery, the areas predicted to exceed the screening threshold for nitrogen deposition correspond to a section of the shore that is accessible to the public. It does not appear that there is any suitable breeding habitat for terns within this area, and adverse effects from nitrogen deposition are considered unlikely. Natural England have also confirmed that breeding terns are unlikely to be found in this area of exceedance.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

3.8.4.2.4.2 Acid deposition

Lee-on-the-Solent is not predicted to exceed the 1% screening threshold for acid deposition.

3.8.4.2.4.3 Airborne NOx

Lee-on-the-Solent is not predicted to exceed the 1% screening threshold for airborne NOx.

3.8.4.3 Detailed consideration of qualifying features

Due to the complexity of Solent and Southampton Water, each qualifying feature is considered in-turn in Table 3-24.

Table 3-24 Detailed consideration of qualifying features for Solent and Southampton Water Ramsar & SPA

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
Ramsar Criterion 1: The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland and rocky boulder reefs.	**Saline Lagoons** Saline lagoons are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No
	Estuaries Estuaries are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No
	Saltmarsh Small areas of saltmarsh are present within the areas predicted to exceed the screening thresholds of all four pollutants. Given saltmarsh is a supporting habitat of the qualifying bird species, the impact of increased airborne air pollution concentrations upon saltmarsh was considered for birds. Analysis in the preceding sections determined that there would be no adverse effects on bird species related to nitrogen deposition, acid deposition, airborne NH_3 or NOx. The areas of saltmarsh included in the areas predicted to exceed the screening thresholds are also small in comparison to the large areas of saltmarsh available elsewhere in the site.	No
	Shallow coastal waters Shallow coastal waters are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No
	Rocky boulder reefs Rocky boulder reefs are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	Coastal woodland A review of HBIC and priority habitat mapping did not identify any coastal woodland within the areas of exceedance and as such adverse impacts from pollutants to this qualifying feature habitat as a result of the short-term development in Fareham Borough are considered unlikely.	No
	Reedbeds Reedbeds commonly occur on ground which is waterlogged for most of the year and subject to tidal influences. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No
	Intertidal flats Intertidal flats are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature .	No
	Grazing marshes Small areas of grazing marsh are present within the areas predicted to exceed the screening thresholds of all four pollutants. The areas of grazing marsh included in the areas predicted to exceed the screening thresholds are small in comparison to the large areas of this habitat available elsewhere in the site. Additionally, grazing marsh is dependent on periodic inundation with tidal waters and high water levels, and as such adverse impacts as a result of the proposed short-term development in Fareham Borough are not anticipated for this feature.	No
Ramsar Criterion 2: The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight	No species list is provided for the Ramsar assemblage qualification however, an assemblage list is provided for the SPA designation. The impacts to all bird species listed within the SPA assemblage list are considered individually therefore any adverse impacts identified for SPA bird species would represent an adverse impact on this assemblage qualification.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
British Red Data Book plants are represented on site.		
Ramsar Criterion 5: Individual qualifying bird species: 51343 waterfowl (5 year peak mean 1998/99-2002/2003)	No species list is provided for the Ramsar assemblage qualification however, an assemblage list is provided for the SPA designation. The impacts to all bird species listed within the SPA assemblage list are considered individually therefore any adverse impacts identified for SPA bird species would represent an adverse impact on this assemblage qualification.	No
Ramsar Criterion 6: Individual qualifying bird species.	All individual qualifying birds are considered under the SPA designation.	N/A
SPA Article 4.1: Little Tern	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.1: Sandwich Tern	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.1: Mediterranean Gull	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	
SPA Article 4.1: Roseate Tern	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Black-tailed Godwit	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
SPA Article 4.2: Ringed Plover	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Dark-bellied Brent Goose	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Dunlin	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Grey Plover	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Redshank	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Little Grebe	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Great Crested Grebe	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Cormorant	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Shelduck	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.1: Common Tern	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
SPA Article 4.2: Curlew	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Pintail	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Red-breasted merganser	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Lapwing	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Gadwall	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Shoveler	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Teal	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No
SPA Article 4.2: Wigeon	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
SPA Article 4.2: Waterbird Assemblage: Gadwall, Teal, Ringed Plover, Black-tailed Godwit, Little Grebe, Great Crested Grebe, Cormorant, Dark-bellied Brent Goose, Wigeon, Redshank, Pintail, Shoveler, Red-breasted Merganser, Grey Plover, Lapwing, Dunlin,Curlew, Shelduck.	All of these birds are considered individually above.	No

3.8.4.4 Assessment summary and conclusions

Adverse effects (pre-mitigation) can be discounted for all qualifying features of the Solent and Southampton Water Ramsar and SPA, and for nitrogen deposition, acid deposition, oxides of nitrogen (NOx) and ammonia (NH_3) as causal pollutants.

On the basis of available evidence, adverse effects on this Ramsar and SPA site can be discounted and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

3.9 Solent Maritime SAC (UK0030059)

3.9.1 Background information and qualifying features

Underlying Sites of Special Scientific Interest (SSSI): Hythe to Calshot Marshes SSSI, Lee-on-the Solent to Itchen Estuary SSSI, Upper Hamble Estuary & Woods SSSI, Bouldnor & Hamstead Cliffs SSSI, Newtown Harbour SSSI, Bracklesham Bay SSSI, Chichester Harbour SSSI, North Solent SSSI, Lower Test Valley SSSI, Langstone Harbour SSSI, Thorness Bay SSSI, Hurst Castle & Lymington River Estuary SSSI, Yar Estuary SSSI, Medina Estuary SSSI, King's Quay Shore SSSI, Eling & Bury Marshes SSSI, Lincegrove & Hackett's Marshes SSSI.

Qualifying and notifiable features associated with this site include: **1130 Estuaries**, **1320 Spartina swards (Spartinion maritimae)**, **1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)**, **1110 Sandbanks which are slightly covered by sea water all the time**, **1140 Mudflats and sandflats not covered by seawater at low tide**, **1150 Coastal lagoons**, **1210 Annual vegetation of drift lines**, **1220 Perennial vegetation of stony banks**, **1310 Salicornia and other annuals colonizing mud and sand**, **2120 "Shifting dunes along the shoreline with Ammophila arenaria (""white dunes"")"**, **1016 Desmoulin`s whorl snail *Vertigo moulinsiana***

The Site Improvement Plan for the SPA (Solent SIP043) states that nitrogen deposition has been identified as a pressure.

The conservation objectives for this site are to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

Areas of Solent Maritime (SAC) overlap with Solent and Southampton Water (Ramsar & SPA) and Chichester and Langstone Harbours (Ramsar and SPA).

3.9.2 HRA Stage 1: Assessment of air quality impacts against screening thresholds

This section comprises the outcome of the assessment described in Section 2.4.

Table 3-25 summarizes all of the critical loads for nutrient nitrogen deposition (kgN/ha-year) and acid deposition (kEq/ha-year), as well as the critical levels for airborne ammonia (µg/m^3), applicable to this designated site. In this table, the most stringent critical load or critical level (CL) for each pollutant is indicated in bold. The critical level for airborne NOx is set at 30 µg/m^3 across all designated sites.

Table 3-25 Minimum Critical Load and Critical Level (CL) values and associated sensitive features for Solent Maritime SAC

Sensitive feature	Minimum nutrient nitrogen deposition CLs (kgN/ha-year)	Minimum acid deposition CLs (MinCLMaxN, kEq/ha-year)	Minimum airborne NH_3 CLs ($\mu g/m^3$)
Perennial vegetation of stony banks	**8**	**0.626**	Site specific advice should be sought
Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")	10	Not sensitive	Site specific advice should be sought
Estuaries	20	Not sensitive	Site specific advice should be sought
Coastal lagoons	20	Not sensitive	Site specific advice should be sought
Salicornia and other annuals colonizing mud and sand	20	Not sensitive	Site specific advice should be sought
Spartina swards (*Spartinion maritimae*)	20	Not sensitive	Site specific advice should be sought
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	20	Not sensitive	Site specific advice should be sought
Sandbanks which are slightly covered by sea water all the time	Not sensitive	Not sensitive	Not sensitive
Mudflats and sandflats not covered by seawater at low tide	No data	Not sensitive	Site specific advice should be sought
Annual vegetation of drift lines	Not sensitive	Not sensitive	Not sensitive
Vertigo moulinsiana - Desmoulin`s whorl snail	No data	Site specific - Species broad habitat sensitive	**3**

Consideration of in-combination effects

The Solent Maritime SAC designated site is contained within the PfSH study area. The PfSH model was used to model the in-combination impacts of short-term development in Fareham borough by scaling the traffic inputs from the PfSH reference year and future year scenarios (2014 and 2034 respectively) to 2023, as described in Section 2.2.4. The dispersion modelling results of the Fareham 2023 DM scenario are therefore representative of air quality impacts associated with road traffic emissions from short-term development in Fareham, as well as in-combination air quality impacts associated with road traffic emissions from anticipated short-term development in East Hampshire (part), Eastleigh, Gosport, Havant, Isle of Wight, New Forest, Portsmouth, Southampton, Test Valley (part), and Winchester (part).

Screening results

Table 3-26 compares the maximum modelled contribution of the Fareham 2023 DM Scenario to the lowest applicable CL. Values highlighted in yellow exceed the 1% screening threshold. This screening exercise represents a precautionary approach, as it assumes that the most sensitive qualifying features (with the lowest CLs) are present in the areas with the highest modelled contribution (typically adjacent to the busiest road).

All four pollutants exceeded the 1% screening threshold for the Fareham 2023 DM scenario, and therefore likely significant effects from air quality impacts cannot be ruled out for any pollutants. A Stage 2 Appropriate Assessment has been undertaken in the following section.

Table 3-26 Screening results based on dispersion modelling of Fareham 2023 DM Scenario:

Pollutant	Deposition type	Minimum CL	Maximum modelled contribution	% of CL
Nutrient nitrogen deposition (kgN/ha-year)	Grassland[a]	8	3.72	46.5%
Acid deposition (kEq/ha-year)	Grassland[a]	0.626	0.26	42.3%
Airborne NOx (µg/m^3)	n/a	30	10.1	33.7%
Airborne NH_3 (µg/m^3)	n/a	3	0.67	22.2%

[a] Although there are pockets of trees within the SAC boundary, these are not associated with the qualifying and notifiable features of the designated site. This site is mainly characterized by marine habitats with short vegetation, and the grassland deposition rates are applicable**.**

3.9.3 HRA Stage 2: Appropriate Assessment

3.9.3.1 Airborne NH_3

The relevant CL for Solent Maritime SAC is 3 µg/m^3 for all features. Figure 3-48 illustrates the areas where the modelled contributions from the Fareham 2023 DM scenario is predicted to exceed 0.03 µg/m^3 (1% of the CL). There are three areas of exceedance: the Redbridge Causeway in the West, the M27 at Lower Swanwick, and Farlington Marshes in the East.

Consideration of background concentrations

Figure 3-49 to Figure 3-51 show the results of the Farehm 2023 DM model scenario added to the background NH_3 concentrations from APIS.[65] The NH_3 concentrations from APIS are on a 5 km x 5 km grid, hence some parts of the figure appear pixelated.

The predicted NH_3 concentration does not exceed the CL of 3 µg/m^3 anywhere within the site boundary. In this case, the maximum predicted concentration was 2.09 µg/m^3 (69.7% of the CL).

On the basis of available evidence and agreed thresholds, there are no adverse effects on this SAC arising from increased airborne NH_3 concentrations associated the Fareham 2023 development scenario.

[65] http://www.apis.ac.uk/popup/gridded-concentration-deposition-2015?sitecode=UK0030059&deptype=M&featurecode=H1220&accode=AG (accessed 10/09/2019)

Figure 3-48 Overview of screening results for airborne ammonia at Solent Maritime SAC

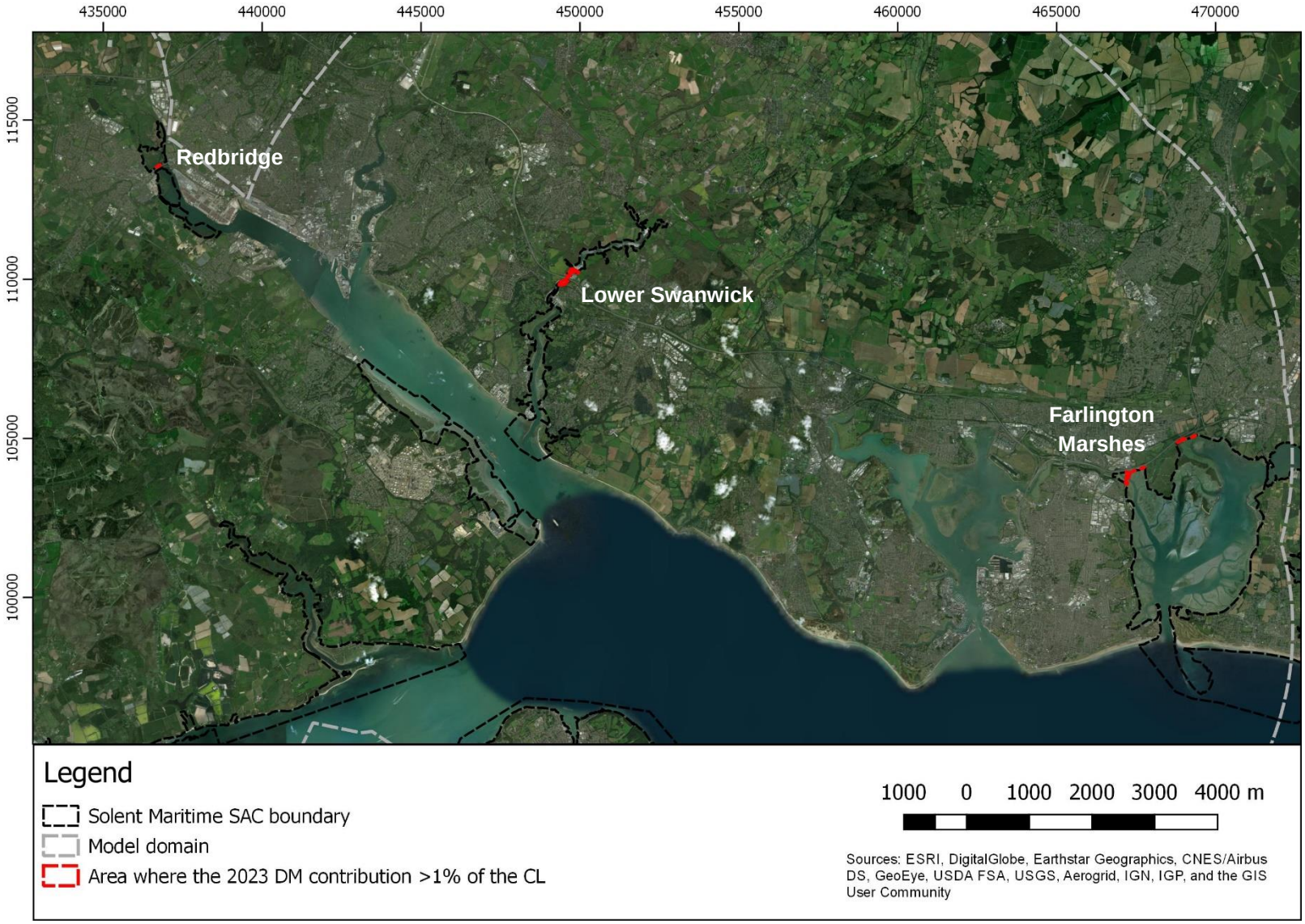


Figure 3-49 Total modelled concentrations of airborne ammonia at Redbridge Causeway, Solent and Southampton Water Ramsar & SPA in 2023

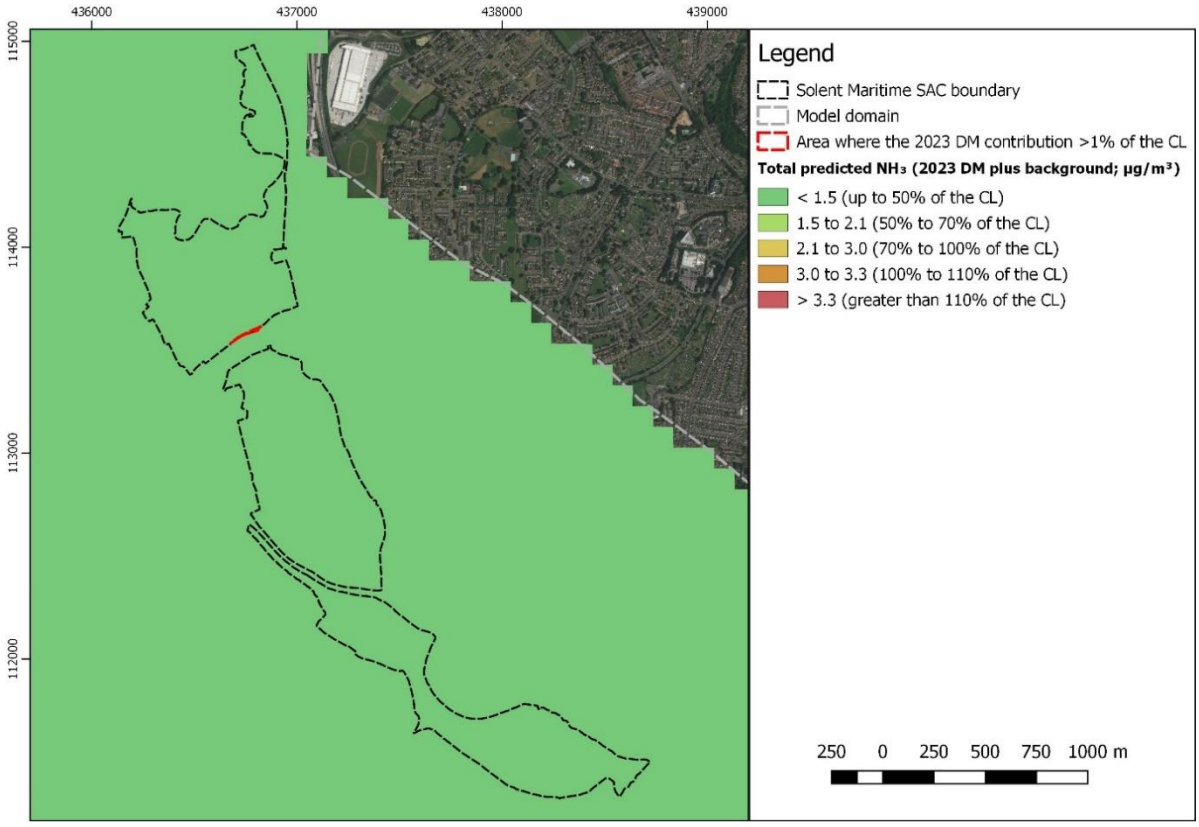


Figure 3-50 Total modelled concentrations of airborne ammonia at the M27 near Lower Swanwick, Solent and Southampton Water Ramsar & SPA in 2023

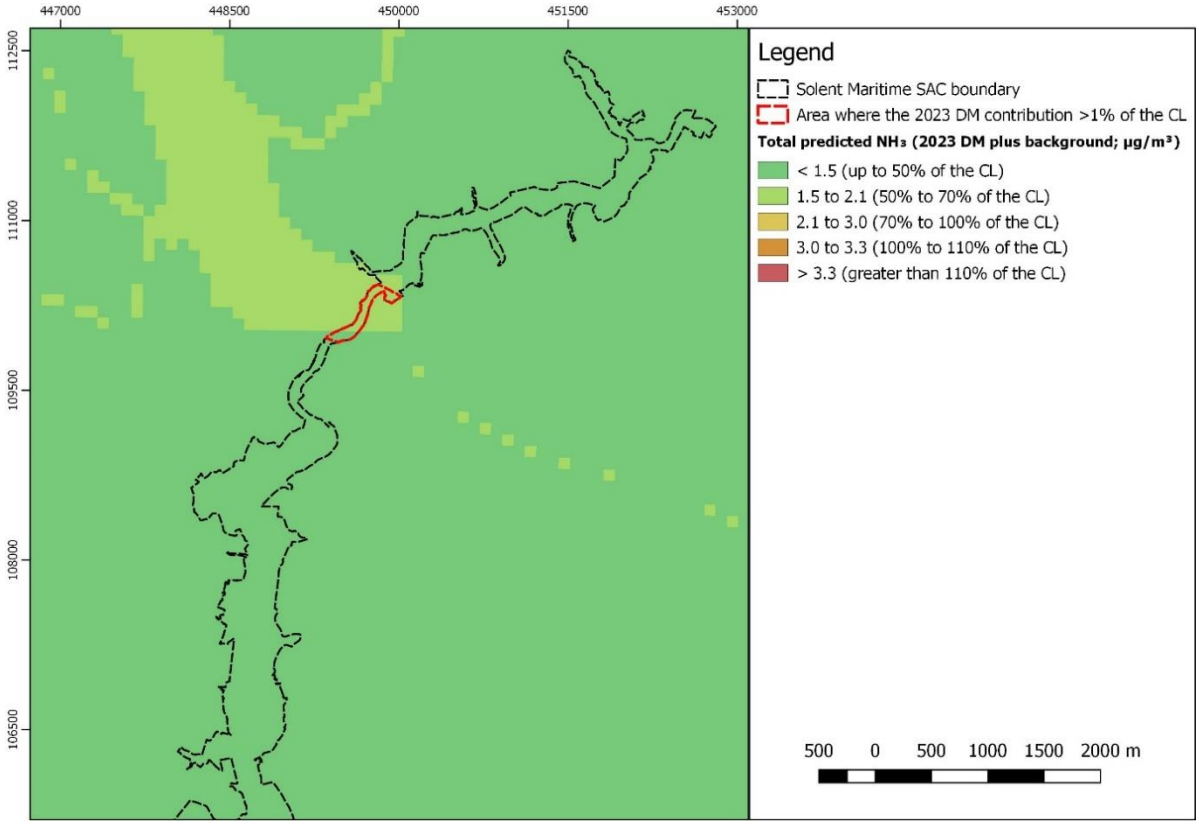
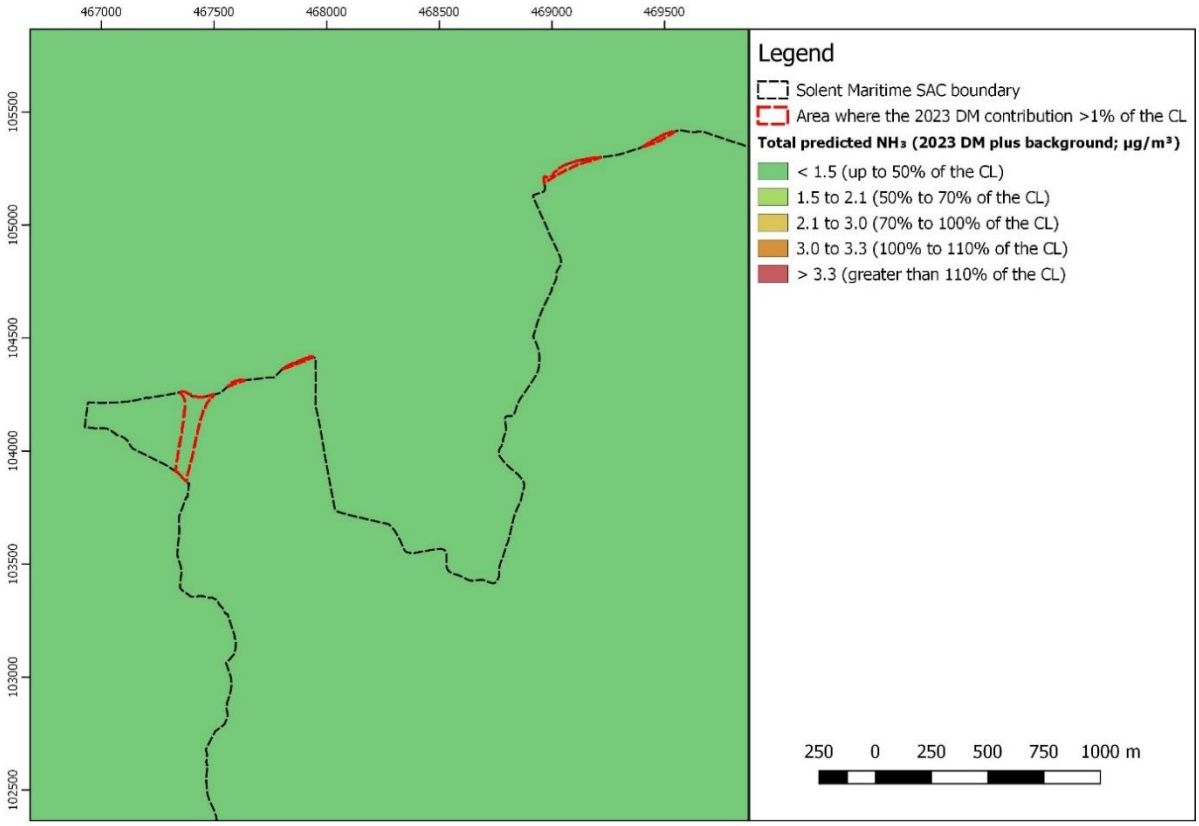


Figure 3-51 Total modelled concentrations of airborne ammonia at Farlington Marshes, Solent and Southampton Water Ramsar & SPA in 2023



3.9.3.2 Other pollutants

Due to the size of the Solent Maritime SAC, the analysis for acid deposition, nitrogen deposition and NOx have been organized by geographical location, followed by consideration for each pollutant at that location. As nitrogen deposition is exceeding the screening threshold by the highest amount, the following figure shows the geographical areas of analysis along with the areas predicted to exceed the screening threshold using both forest (red) and grassland (yellow) deposition rates.

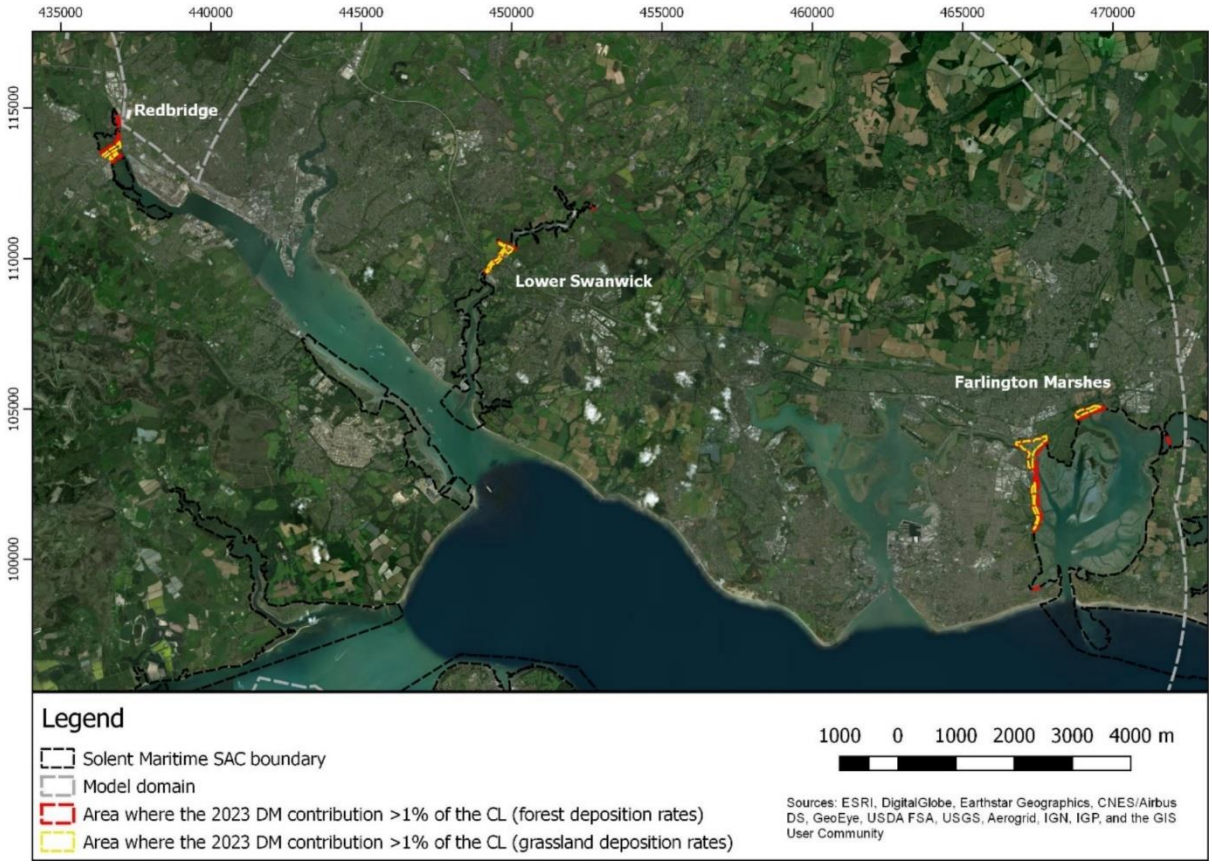
Summary of critical loads for nitrogen deposition:

- The lowest CL is 8 – 15 kgN/ha-year for Perennial vegetation of stony banks; equivalent class coastal stable dune grasslands.
- A higher CL of 10 – 20 kgN/ha-year is set for Shifting dunes along the shoreline with *Ammophila arenaria* (“white dunes”); equivalent class shifting coastal dunes.

A CL of 20 – 30 kgN/ha-year applies for other features, such as Atlantic salt meadows and Spartina swards.

Figure 3-52 illustrates the areas where the nitrogen deposition modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL). Three areas of exceedance were identified: Redbridge, Lower Swanwick and Farlington Marshes.

Figure 3-52 Overview of screening results for nitrogen deposition at Solent Maritime SAC, assuming a CL of 8 kgN/ha-year



Summary of critical loads for acid deposition:

- Perennial vegetation of stony banks is the only feature listed as being sensitive to acid deposition, with the corresponding acidity class of 'acid grassland' and a CLMaxN ranging from 0.626 – 4.608 kEq/ha-year.

Figure 3-53 illustrates the areas where the acid deposition modelled contributions from the Fareham 2023 DM scenario are predicted to exceed 0.00626 kgN/ha-year (1% of the lowest CL). Three of the four areas of exceedance are identified as similar to those for nitrogen deposition: Redbridge, Northam and Lower Swanwick.

The critical load for acid deposition varies by location, depending on factors such as local soil chemistry. The "Search by Location" tool on APIS[66] has been used to extract relevant parameters (background deposition, CLmaxS, CLminN and CLmaxN) at each of the assessment points listed in the table based on the 'acid grassland' habitat type for PVSB. The "Critical Load Function Tool" on APIS was then used to calculate both the process contribution (PC, equivalent to the modelled contribution from the Fareham 2023 DM scenario) and the total predicted environmental concentration (PEC, equivalent to the PC plus the background deposition) as a percentage of the critical load (CL) function.

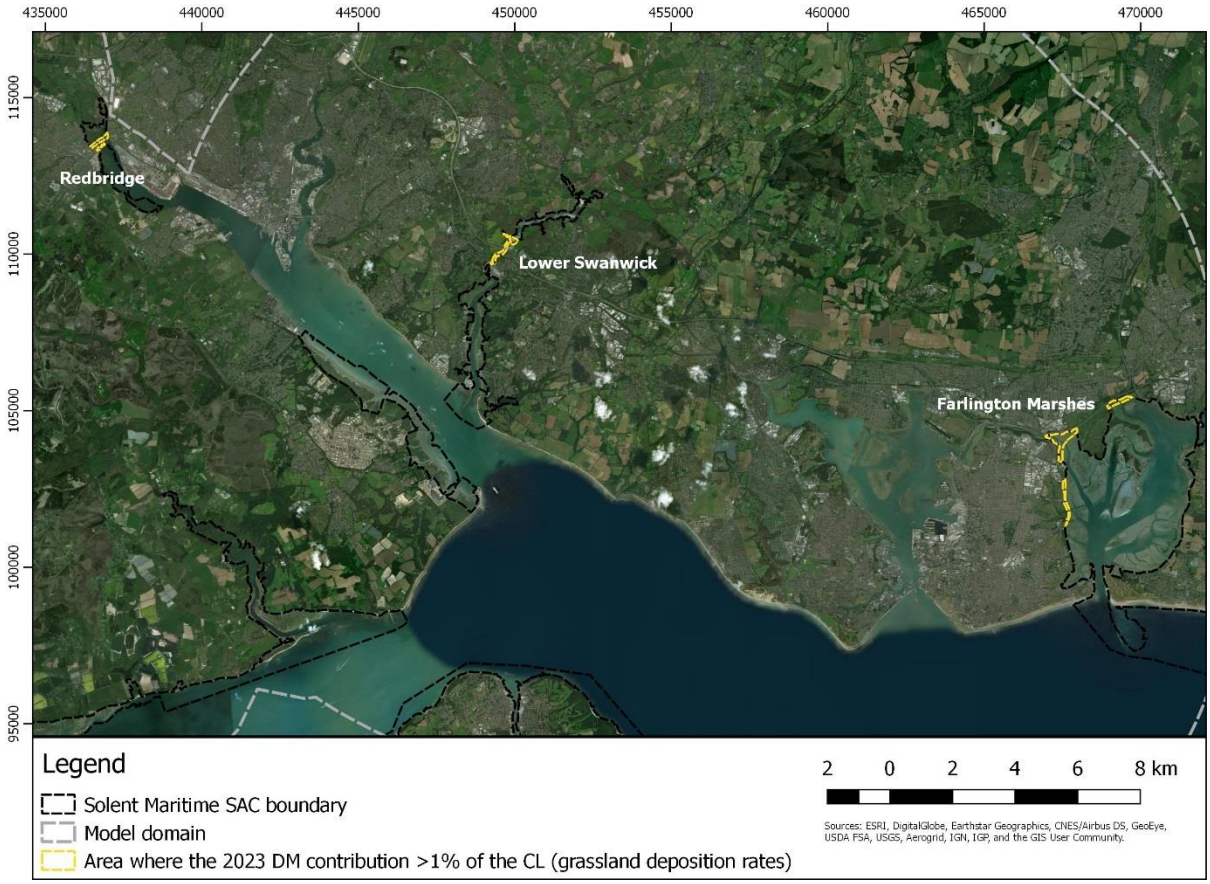
This process has been used for acid deposition analysis throughout the various areas of exceedance within the Solent Maritime SAC.

Summary of critical loads for airborne NOx:

The relevant CL for airborne NOx at Solent Maritime SAC is 30 µg/m^3 for all vegetation.

[66] Air Pollution Information Systems (APIS) Search by Location tool, http://www.apis.ac.uk/search-location, accessed 18/09/2019.

Figure 3-53 Overview of screening results for acid deposition at Solent Maritime SAC, assuming grassland deposition rates and a CL of 0.626 kEq/ha-year



3.9.3.2.1 Area 1: Farlington Marshes / A27

3.9.3.2.1.1 Nitrogen deposition

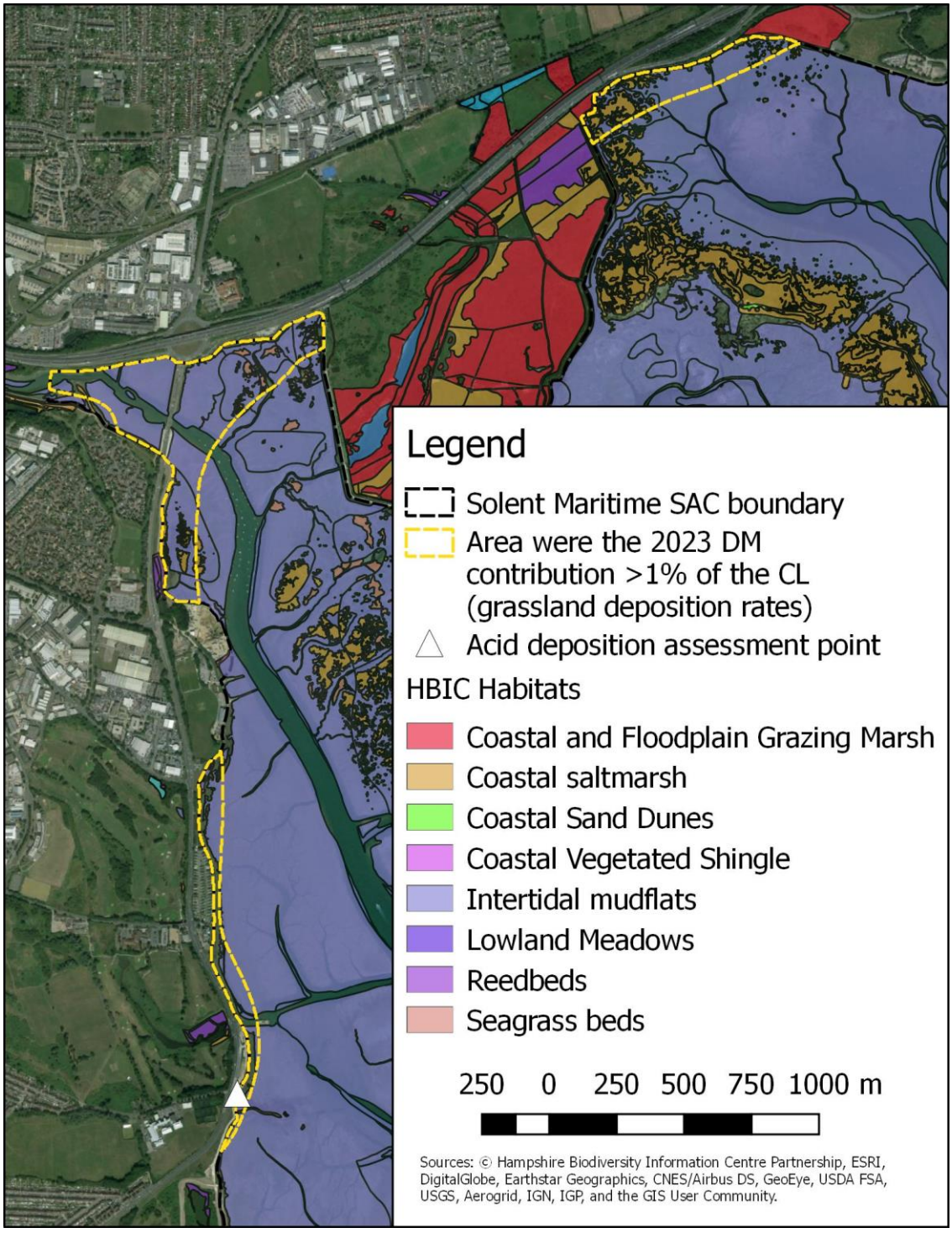
Figure 3-54 illustrates the Farlington Marshes area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

This area has recently been assessed as part of the Havant HRA study.[38] For those areas of Farlington Marshes predicted to exceed the 1% screening threshold (with a CL of 8 kgN/ha-year), APIS indicates that the current background nitrogen deposition in this area of the Solent Maritime site[67] ranges from 11.34 to 13.86 kgN/ha-year. The model results predict that the highest contribution from the Fareham 2023 DM scenario in this area of the Solent Maritime SAC is 0.8 kgN/ha-year, occurring on the road surface of the A2030 just south of the A27. The worst-case total predicted deposition rate, assuming a background deposition rate of 13.86 kgN/ha-year and a Fareham 2023 DM contribution of 0.8 kgN/ha-year, is 14.66 kgN/ha-year. This is below 20 kgN/ha-year, and based on this analysis, we can conclude that there will not be an adverse effect on areas of the designated site where a CL of 20 is applicable.

Additionally, site survey work carried out in December 2018 did not identify any sand dunes within the areas predicted to exceed the screening thresholds. As such, the remaining assessment for nitrogen deposition in this area of the Solent Maritime is focused on potential impacts to PVSB.

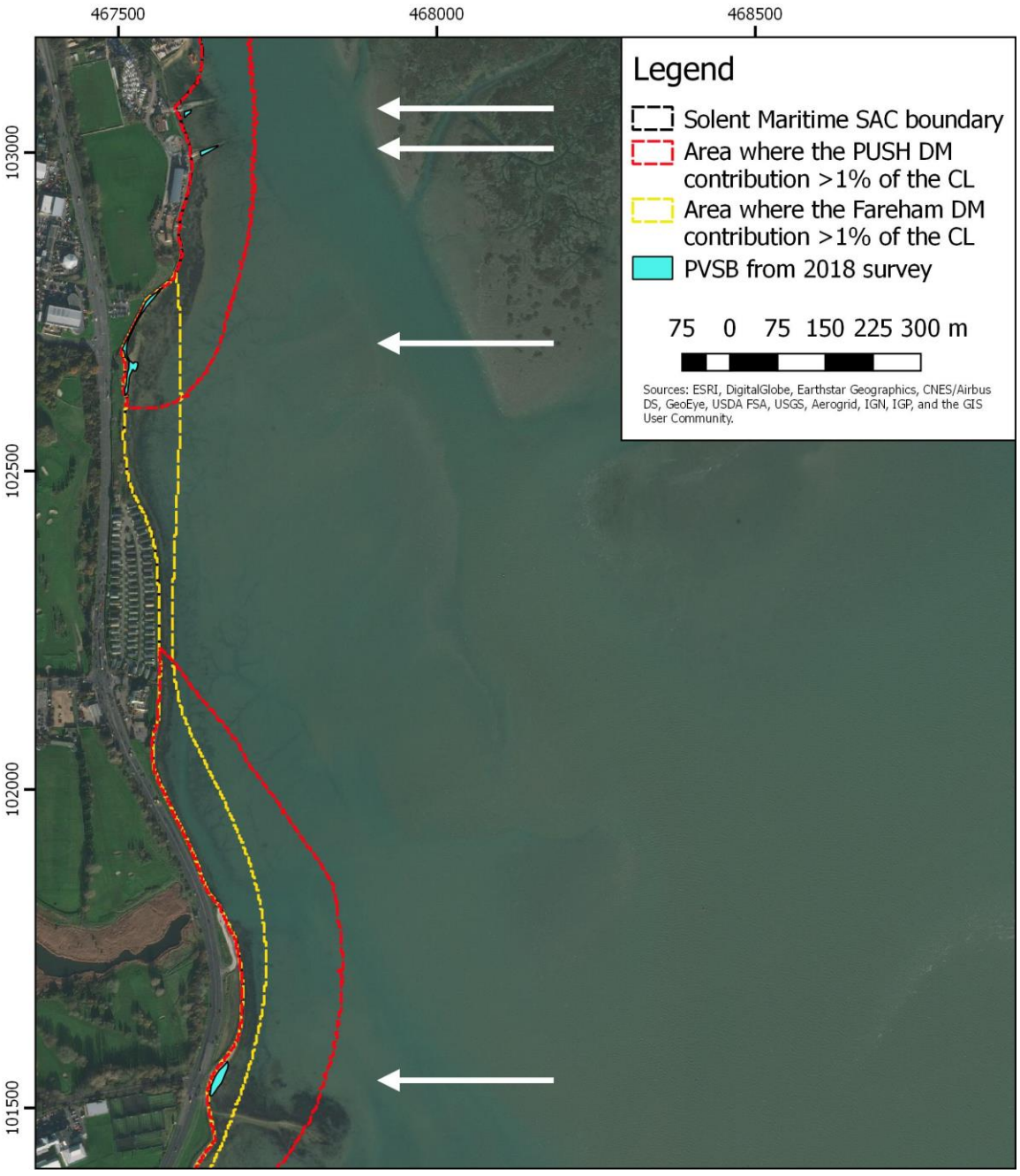
[67] Site/Feature Information, Solent Maritime, http://www.apis.ac.uk/popup/gridded-concentration-deposition-2019?sitecode=UK0030059&deptype=M&featurecode=H1220&accode=AG, accessed 16/08/2019

Figure 3-54 Areas where the modelled DM contribution of nitrogen deposition exceeds 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year, at Solent Maritime SAC: Farlington Marshes/A27



During ground-truthing site surveys carried out in December 2018 for Havant, PVSB was identified in four discrete locations within the areas predicted to exceed the screening thresholds for nitrogen deposition in the Havant scenario. The area predicted to exceed the screening threshold for the Fareham scenario is smaller and contains 2 of the 4 locations where PVSB was identified. These are illustrated in Figure 3-55.

Figure 3-55 Areas where the modelled DM contribution of nitrogen deposition exceeds 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year, and locations of PVSB at Solent Maritime SAC: Farlington Marshes/A27



According to APIS, the current background nitrogen deposition in the area with PVSB is 12.88 kgN/ha/year, which already exceeds the minimum CL for PVSB (8 kgN/ha/year). The Havant HRA study[38] concluded that, on the basis of the available evidence, adverse effects (pre-mitigation) from nitrogen deposition on PVSB cannot be ruled out. It was advocated that Havant develop a joint Nitrogen Action Plan with Portsmouth City Council under the Duty to Co-Operate. This work is ongoing and is likely to begin with air quality monitoring, in order to verify the existing baseline conditions and determine what mitigation might be necessary. The Havant HRA report concluded that with the application of a joint Nitrogen Action Plan, adverse effects on the qualifying features (PVSB) of the Solent Maritime SAC can be prevented.[38]

For the Farlington Marshes area, the area affected by in-combination development to 2023 is smaller than for in-combination development to 2036 (considered in the Havant HRA).[38] As a Nitrogen Action Plan is already under development, no adverse effects are expected from proposed short-term development in Havant. This will need to be considered further when considering the potential impact of longer term development as set out in the Local Plan HRA, and is likely to include further work with HBC on their Nitrogen Action Plan.

Natural England has confirmed that provided Fareham Borough Council has agreed that this issue will be reassessed as part of the local plan HRA, including further discussions with Havant Borough Council and other neighbouring authorities as required, no further comments are raised about this approach.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario; this conclusion is reliant in the development and implementation of a joint Nitrogen Action Plan to mitigate the potential negative effects of nitrogen deposition on PVSB.

3.9.3.2.1.2 Acid deposition

The “Search by Location” tool on APIS[66] has been used to extract relevant parameters (background deposition, CLmaxS, CLminN and CLmaxN) at the assessment point listed in Table 3-27 and illustrated in Figure 3-54, based on the ‘acid grassland’ habitat type for PVSB. The assessment shows that the Process Contribution does not exceed 1% of the CL, and the Predicted Environmental Concentration (PEC) does not exceed the CL, representing only 24.4%.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

Table 3-27 Summary of acid deposition point analysis for known location of PVSB at Solent Maritime SAC: Farlington Marshes/A27

Acid deposition analysis	Farlington Marshes
Assessment point (Easting, Northing)	467651,101545
Rationale for assessment point	Location of PVSB
Deposition rate	grassland
PC for Fareham 2023 DM contribution (kEq/ha-year)	0.01343
Background N deposition (kEq/ha-year)	0.92
Background S deposition (kEq/ha-year)	0.28
CLmaxS (kEq/ha-year; acid grassland)	4.12
CLminN (kEq/ha-year; acid grassland)	0.438
CLmaxN (kEq/ha-year; acid grassland)	**4.558**
PC as % of CL function	0.2
PEC as % of CL function	24.4
Assessment	**The PC is <1% of the CL, and the PEC does not exceed the CL; no significant adverse effects are anticipated.**

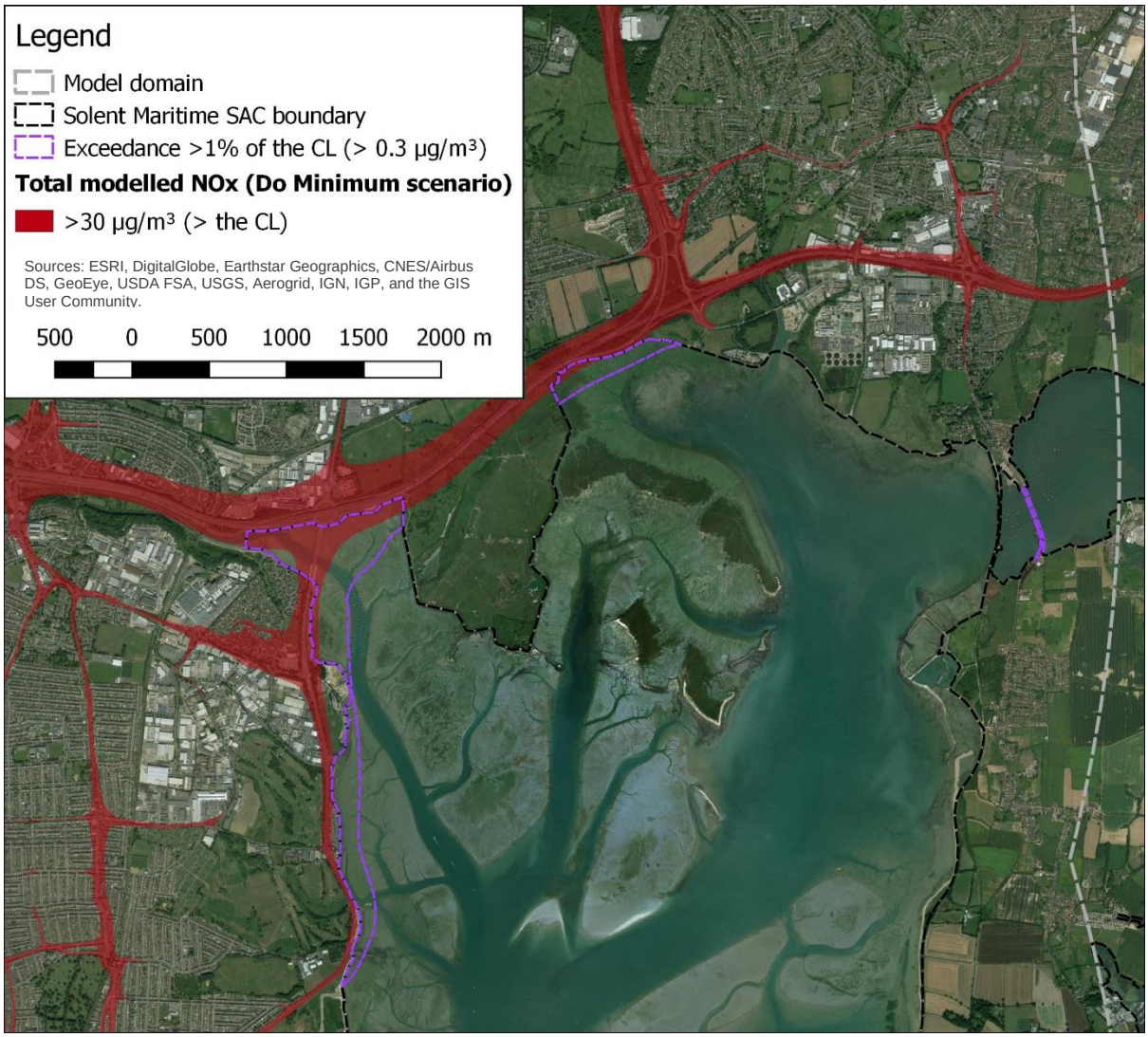
3.9.3.2.1.3 Airborne NOx

Figure 3-56 illustrates the Farlington Marshes area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas in Farlington Marshes which overlap with the red portions of the map, where total predicted concentrations in 2023 exceed 30 µg/m^3, are classified as intertidal mudflats. Intertidal mudflats are regularly inundated by tidal waters, as supported by the Mean High Water mark[42] and thus air pollution impacts are not expected to be significant.

Due to the intertidal nature of the area, there are no adverse effects on this part of the SAC site arising from increased airborne NOx concentrations associated with the Fareham 2023 DM development scenario.

Figure 3-56 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m^3 for oxides of nitrogen (NOx) at Solent Maritime SAC: Farlington Marshes/A27



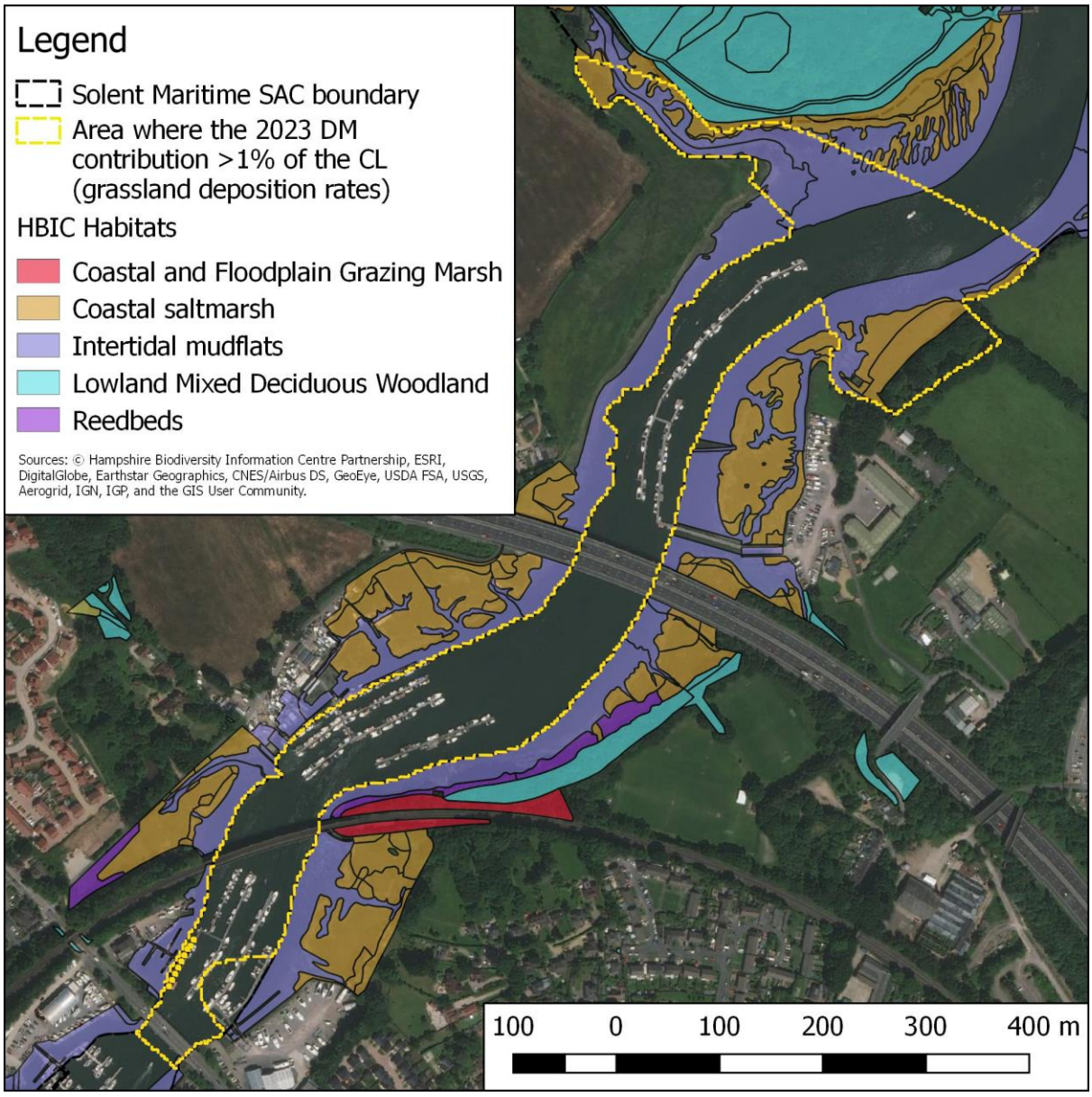
3.9.3.2.2 Area 2: Lower Swanwick / M27

3.9.3.2.2.1 Nitrogen deposition

Figure 3-57 illustrates the Lower Swanwick area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

For those areas predicted to exceed the 1% screening threshold (with a CL of 8 kgN/ha-year), APIS indicates that the current background nitrogen deposition in this area of the Solent Maritime site[67] ranges from 14.42 to 19.04 kgN/ha-year. The model results predict that the highest contribution from the Fareham 2023 DM scenario in this area of the Solent Maritime SAC is 3.7 kgN/ha-year, occurring on the road surface of the M27 where it crosses the River Hamble.

Figure 3-57 Areas where the modelled DM contribution of nitrogen deposition exceeds 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year, at Solent Maritime SAC: Lower Swanwick/M27



The worst-case total predicted deposition rate, assuming a background deposition rate of 19.04 kgN/ha-year and a Fareham 2023 DM contribution of 3.7 kgN/ha-year, is 22.7 kgN/ha-year. The areas where

the total nitrogen deposition exceeds 20 kgN/ha-year consist of the road and river running beneath it, shown in Figure 3-58. These are areas either where sensitive features would not be present (the road surface) or where air pollution would not be likely to accumulate (the open river). Based on this analysis, we can conclude that there will not be an adverse effect on features of the designated site with a CL of 20. The remaining analysis will focus on the more sensitive features, namely PVSB and shifting dunes.

Figure 3-58 Areas where the modelled DM contribution exceeds 1% of the CL assuming a CL of 8 kgN/ha-year, and total modelled nitrogen deposition assuming grassland deposition rates and a CL of 20 kgN/ha-year, at Solent Maritime SAC: Lower Swanwick/M27

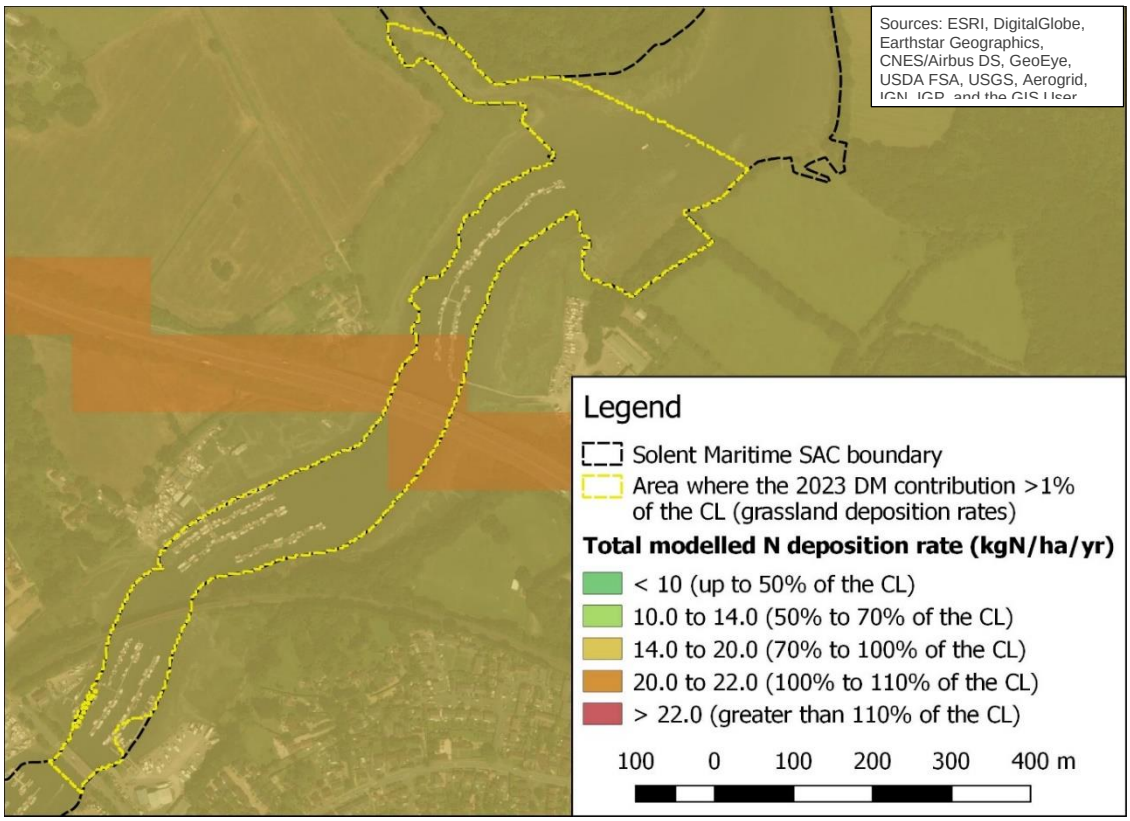
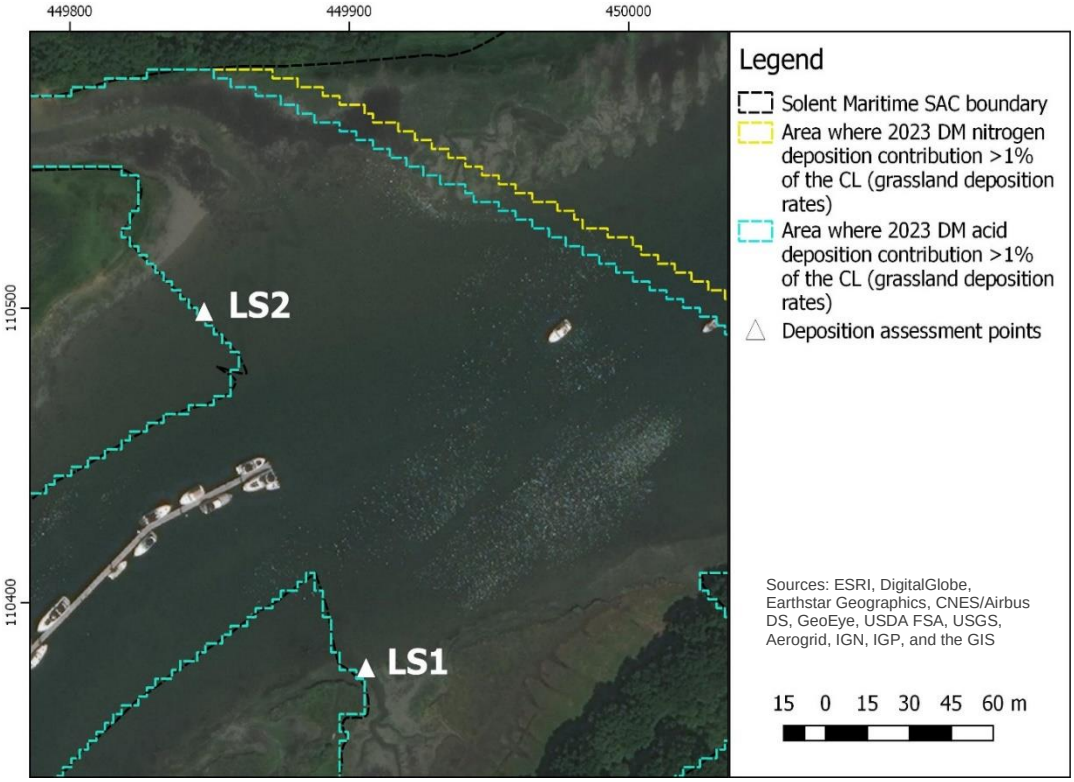


Table 3-28 Summary of nitrogen deposition point analysis for highest modelled concentration in areas infrequently flooded at Solent Maritime SAC: Lower Swanwick/M27

Nitrogen deposition analysis	LS1	LS2
Assessment point (Easting, North)	449906,110378	449848,110499
Rationale for assessment point	Highest modelled concentration along the southern shore	Highest modelled concentration along the northern shore
PC for Fareham 2023 DM contribution (kN/ha-year)	0.25079	0.16192
PC as % of PVSB CL (8 kgN/ha-year)	3.1	2.0
PC as % of sand dunes CL	2.5	1.6
Assessment	**The PC exceeds 1% of the CL for both PVSB and sand dunes habitat types.**	**The PC exceeds 1% of the CL for both PVSB and sand dunes habitat types.**

To assess air quality impacts on portions of the SAC that are not regularly flooded, two points were investigated more closely. The locations of these assessment points are illustrated in Figure 3-59 and the results are presented in Table 3-28.

Figure 3-59 Critical load function assessment locations in areas where nitrogen and acid deposition exceed 1% of the CL, assuming grassland deposition rates and CLs of 8 kgN/ha-year and 0.626 kEq/ha-year respectively, at Solent Maritime SAC: Lower Swanwick/M27



Although the PC and the PEC exceed the respective critical level thresholds for PVSB and shifting dunes, Natural England have confirmed the absence of Shifting dunes and/or PVSB in this area of exceedance.[40]

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

3.9.3.2.2.2 Acid deposition

The “Search by Location” tool on APIS[66] has been used to extract relevant parameters (background deposition, CLmaxS, CLminN and CLmaxN) at each of the assessment points listed in Table 3-29 and illustrated in Figure 3-59, based on the ‘acid grassland’ habitat type for PVSB.

As the PC is <1% of the CL at acid deposition assessment point LS2, we would not expect significant effects arising from increased acid deposition in the general area. Despite the PC and PEC exceeding their respective thresholds at acid deposition assessment point LS1, Natural England have confirmed the absence of Shifting dunes and/or PVSB in this area of exceedance.[40] Therefore, the same conclusions from Section 3.9.3.2.2.1 apply.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

Table 3-29 Summary of acid deposition point analysis for highest modelled concentration in areas infrequently flooded at Solent Maritime SAC: Lower Swanwick/M27

Acid deposition analysis	LS1	LS2
Assessment point (Easting, North)	449906,110378	449848,110499
Rationale for assessment point	Highest modelled concentration along the southern shore	Highest modelled concentration along the northern shore
PC for Fareham 2023 DM contribution (kEq/ha-year)	0.01785	0.01153
Background N deposition (kEq/ha-year)	1.36	1.36
Background S deposition (kEq/ha-year)	0.36	0.36
CLmaxS (kEq/ha-year; acid grassland)	0.93	0.93
CLminN (kEq/ha-year; acid grassland)	0.438	0.438
CLmaxN (kEq/ha-year; acid grassland)	**1.368**	**1.368**
PC as % of CL function	1.5	0.7
PEC as % of CL function	127.2	126.5
Assessment	**The PC exceeds 1% of the CL and the PEC exceeds the CL.**	**The PC is <1% of the CL but the PEC exceeds the CL.**

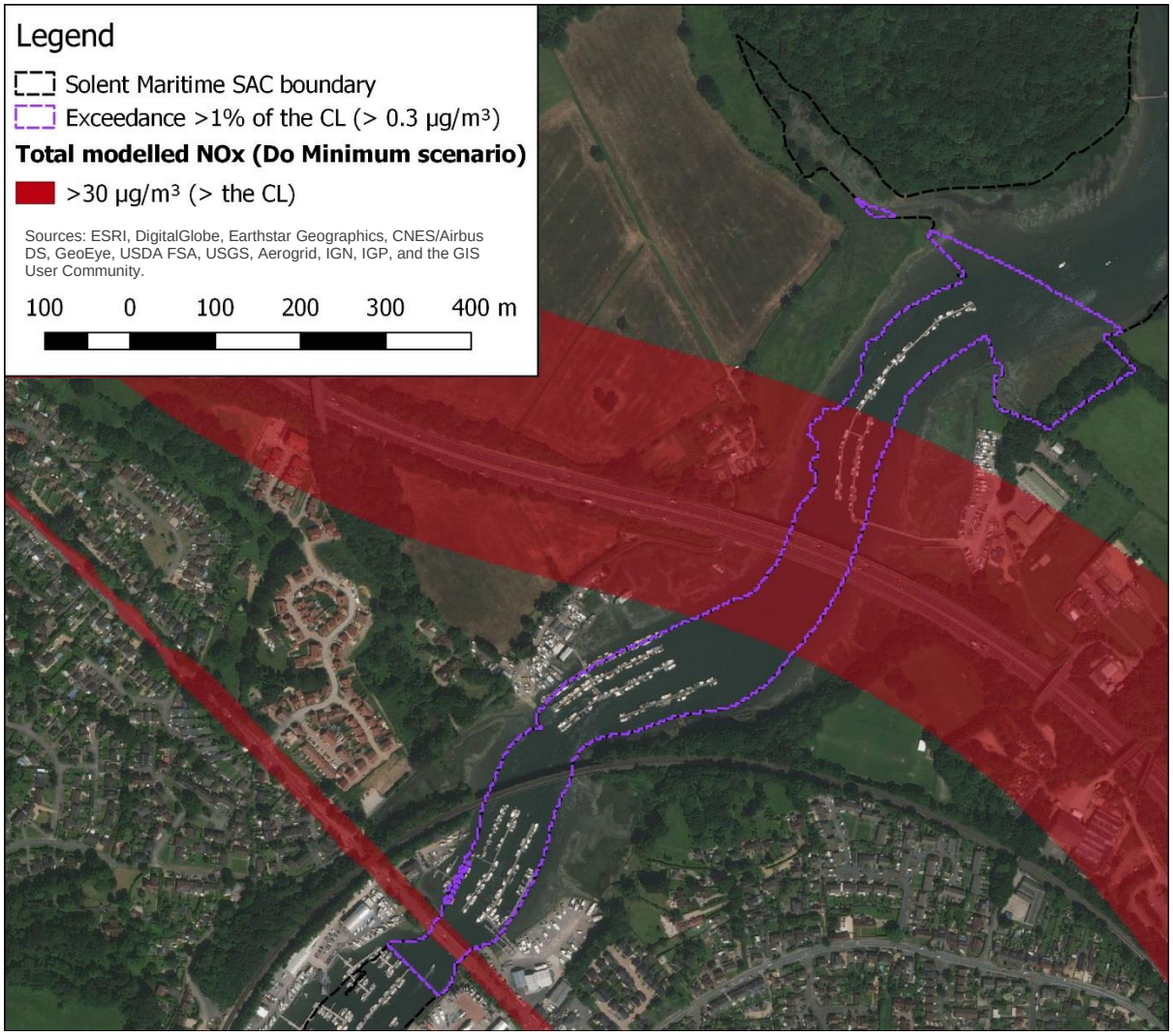
3.9.3.2.2.3 Airborne NOx

Figure 3-60 illustrates the Lower Swanwick area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas in Lower Swanwick which overlap with the red portions of the map, where total predicted concentrations in 2023 exceed 30 µg/m^3, correspond with road surfaces (the M27 and the A27) and areas of the River Hamble covered by water. Air pollution impacts are not expected to be significant.

On the basis of available evidence, there are no adverse effects on this part of the SAC site arising from increased airborne NOx concentrations associated with the Fareham 2023 DM development scenario.

Figure 3-60 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m³ for oxides of nitrogen (NOx) at Solent Maritime SAC: Lower Swanwick/M27



3.9.3.2.3 Area 3: Redbridge / Totton Bypass

3.9.3.2.3.1 Nitrogen deposition

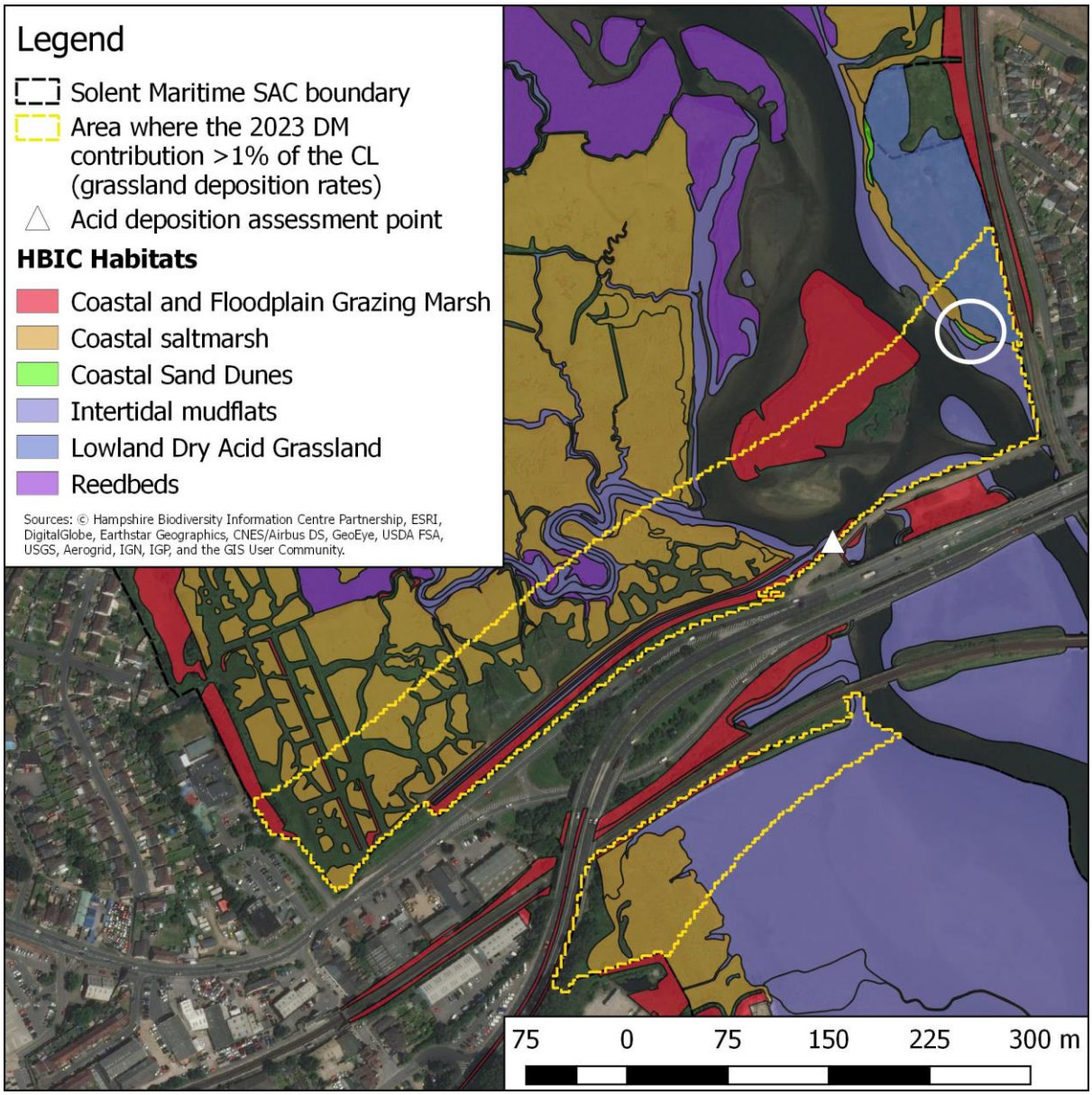
Figure 3-61 illustrates the Redbridge Causeway area where the modelled contributions to nitrogen deposition from the Fareham 2023 DM scenario are predicted to exceed 0.08 kgN/ha-year (1% of the lowest CL).

For those areas predicted to exceed the 1% screening threshold (with a CL of 8 kgN/ha-year), APIS indicates that the current background nitrogen deposition in this area of the Solent Maritime site[67] is 15.96 kgN/ha-year. The model results predict that the highest contribution from the Fareham 2023 DM scenario in this area is 0.35 kgN/ha-year, occurring immediately north of the Redbridge Causeway road surface. The worst-case total predicted deposition rate, assuming a background deposition rate of 15.96 kgN/ha-year and a Fareham 2023 DM contribution of 0.35 kgN/ha-year, is 16.31 kgN/ha-year. This is below 20 kgN/ha-year, and based on this analysis, we can conclude that there will not be an adverse effect on areas of the designated site where a CL of 20 is applicable.

The background nitrogen deposition rate (15.96 kgN/ha-year) and the worst-case total predicted nitrogen deposition rate (16.31 kgN/ha-year) are above the CL range for PVSB (8 to 10 kgN/ha-year) and towards the upper limit of the CL range for shifting dunes (10 to 20 kgN/ha-year). The HBIC dataset indicates that there is a small area of coastal sand dunes (circled in white in Figure 3-61). It is not

possible to tell with the HBIC dataset or satellite imagery if PVSB occurs in this area, however, Natural England have confirmed the absence of Shifting dunes and/or PVSB in this area of exceedance.[40]

Figure 3-61 Areas where the modelled DM contribution of nitrogen deposition exceeds 1% of the CL, assuming grassland deposition rates and a CL of 8 kgN/ha-year, at Solent Maritime SAC: Redbridge/Totton Bypass



On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased nitrogen deposition associated with the Fareham 2023 DM development scenario.

3.9.3.2.3.2 Acid deposition

The critical load for acid deposition varies by location, depending on factors such as local soil chemistry. The “Search by Location” tool on APIS has been used to extract relevant parameters (background deposition, CLmaxS, CLminN and CLmaxN) at the assessment point in Table 3-30 and shown in Figure 3-61, based on the ‘acid grassland’ habitat type for PVSB.

Table 3-30 Summary of acid deposition point analysis for highest modelled concentration at Solent Maritime SAC: Redbridge/Totton Bypass

Acid deposition analysis	Redbridge / Totton Bypass
Assessment point (Easting, Northing)	436859, 113646
Rationale for assessment point	Highest modelled concentration along the shore, where the sensitive qualifying features could theoretically exist
Deposition rate	Grassland
PC for Fareham 2023 DM contribution (kEq/ha-year)	0.017
Background deposition N (kEq/ha-year)	1.14
Background deposition S (kEq/ha-year)	0.33
CLmaxS (kEq/ha-year; acid grassland)	0.92
CLminN (kEq/ha-year; acid grassland)	0.438
CLmaxN (kEq/ha-year; acid grassland)	**1.358**
PC as % of CL function	1.5
PEC as % of CL function	109.7
Assessment	**The PC is >1% of the CL and the PEC exceeds the CL.**

Despite the PC and PEC exceeding their respective thresholds at the acid deposition assessment point, Natural England have confirmed the absence of Shifting dunes and/or PVSB in this area of exceedance.[40] Therefore, the same conclusions from Section 3.9.3.2.3.1 apply.

On the basis of available evidence, including the spatial distribution of sensitive qualifying features and their applicable CLs, there are no adverse effects on this area of the SAC site arising from increased acid deposition associated with the Fareham 2023 DM development scenario.

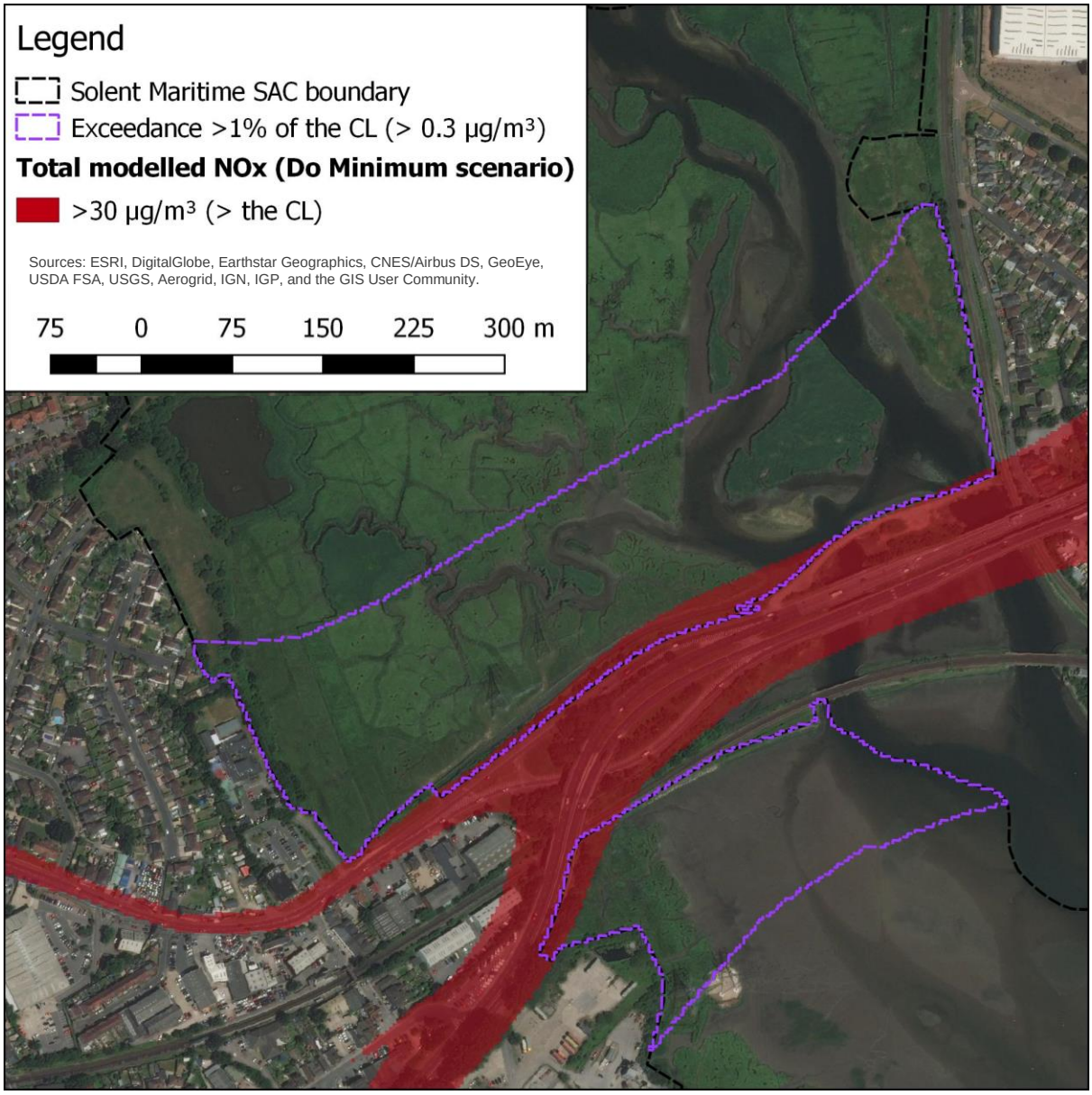
3.9.3.2.3.3 Airborne NOx

Figure 3-62 illustrates the Redbridge Causeway area where the modelled contribution from the Fareham 2023 DM scenario is predicted to exceed 0.3 µg/m^3 (1% of the CL).

The areas in Redbridge/Totton Bypass which overlap with the red portions of the map, where total predicted concentrations in 2023 exceed 30 µg/m^3, extend up to approximately 30m north and south from sections of the Bypass road surface. The areas predicted to experience total concentrations greater than 30 µg/m^3 are classified in the HBIC dataset as a mixture of: coastal and floodplain grazing marsh, intertidal mudflat and coastal saltmarsh. Both intertidal mudflat, as well as coastal and floodplain grazing marsh, habitat types are inundated regularly with tidal water and air pollution impacts are not expected to be significant in these areas. While there is a small area of saltmarsh, this represents a very small area when compared to the large areas of saltmarsh available elsewhere in the SAC.

Natural England have confirmed that there are no sensitive features (shifting dunes or PVSB) present in the areas where the DM contribution exceeds 1% of the CL and the total modelled NOx for the Fareham 2023 DM scenario exceeds the CL.[40] Therefore, on the basis of available evidence, there are no adverse effects on this area of the SAC site arising from increased NOx associated with the Fareham 2023 DM scenario.

Figure 3-62 Areas where the modelled DM contribution exceeds 1% of the CL, and total modelled concentrations exceed 30 µg/m³ for oxides of nitrogen (NOx) at Solent Maritime SAC: Redbridge/Totton Bypass



3.9.3.3 Detailed consideration of qualifying features

Due to the complexity of Solent Maritime, each qualifying feature is considered in-turn in Table 3-31.

Table 3-31 Detailed consideration of qualifying features for Solent Maritime SAC

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
Coastal saltmarsh habitats: **H1320 Spartina swards (*Spartinion maritimae*)** **H1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)** **H1310 Salicornia and other annuals colonizing mud and sand**	A small area of saltmarsh is present within the areas predicted to exceed the screening thresholds for all four pollutants. <u>Nitrogen deposition</u> The CL applicable to saltmarsh is 20-30 kgN/ha-year. At all areas within the designated site where saltmarsh could be present, the background level of nitrogen deposition plus the contribution from the Fareham 2023 DM scenario was <20 kgN/ha-year, and therefore no adverse effects are anticipated for saltmarsh. <u>Acid deposition</u> APIS states that Spartina swards (*Spartinion maritimae*) and Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), are not sensitive to acidification. <u>NOx</u> Dispersion modelling of the Fareham 2023 DM scenario and analysis using aerial imagery identified three locations where NOx exceeded the 1% screening threshold. Further analysis using forecast background levels of NOx indicated that saltmarsh habitats were not present in the areas predicted to experience total NOx concentrations > 30 µg/m^3 in 2023 for two of the areas (Farlington Marshes / A27 and Lower Swanwick / M27). Small areas of saltmarsh are predicted to experience total NOx concentrations > 30 µg/m^3 in 2023 in the Redbridge / Totton Bypass area. These small areas of saltmarsh comprise a very small portion of the total saltmarsh habitat available in the entirety of the Solent Maritime SAC, and adverse effects on the integrity of the site are not anticipated. <u>NH_3</u> Dispersion modelling of the Fareham 2023 DM scenario and analysis using aerial imagery identified three locations where NH_3 exceeded the 1% screening threshold. Further analysis using the current background levels of NH_3 indicated that the total modelled NH_3 did not exceed the CL 3 µg/m^3 anywhere within the designated site boundary. As the total modelled concentration is not predicted to exceed the CL, no adverse effects are anticipated.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
1130 Estuaries	Estuaries are routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Significant adverse impacts as a result of the proposed short-term development in Fareham Borough are therefore not anticipated for this feature.	No
1110 Sandbanks which are slightly covered by sea water all the time	APIS states that this habitat is not sensitive to any of the four pollutants, therefore adverse impacts as a result of short-term development in Fareham Borough are considered highly unlikely.	No
1140 Mudflats and sandflats not covered by seawater at low tide	This habitat is routinely inundated as a result of the daily tidal influence. As a result, any accumulation of airborne pollutants would be flushed away and/or diluted by the washing over of the tide. Adverse impacts as a result of short-term development in Fareham Borough are therefore not anticipated for this feature.	No
1150 Coastal lagoons	The SAC includes two coastal lagoons on the Isle of Wight, namely Newtown Quay and Yar Bridge Lagoon. Both lagoons in the Solent Maritime SAC are sluiced lagoons, with water flow controlled via culverts and pipes or sluices. Although the habitat is sensitive to nitrogen deposition and airborne NOx/NH_3, the locations of the lagoons are not within the exceedance areas for any of the pollutants. Therefore, significant adverse effects are considered highly unlikely for coastal lagoons.	No
1210 Annual vegetation of drift lines	APIS states that this habitat is not sensitive to any of the four pollutants.	No
1220 Perennial vegetation of stony banks	Four small areas of perennial vegetation of stony banks (PVSB) were identified at the western shore of Langstone Harbour during targeted field survey to inform the Appropriate Assessment for the Havant Borough Local Plan.[38] These areas of PVSB cover an area of approximately 0.15ha. Two of these areas are present in the area predicted to exceed the screening thresholds for the Fareham 2023 DM scenario.	**Yes; from nitrogen deposition**

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
	Analysis in the preceding sections determined that there would be no adverse effect on bird species related to nitrogen deposition, acid deposition, airborne NOx or airborne NH_3. Nitrogen Deposition At a Critical Level of 8kgN/ha-year, the background level of nitrogen deposition within the areas predicted to exceed the screening threshold already exceed the Critical Level. Based on observations made during the site survey, it is thought that the threat to this PVSB vegetation (which comprises of *Beta vulgaris* subsp *maritima)* is from being encroached and ultimately outcompeted by colonising tall rough grassland as a result of increased nitrogen levels. Next to one area of PVSB is an adjacent raised stand of rough grassland which has either colonised due to more soil in the shingle substrate, in response to increased nitrogen already occurring there or a combination of both factors. Although the area of this qualifying feature habitat within the area of exceedance is very small compared to the overall size of the SAC (11243ha), the overall coverage of this qualifying feature within the SAC is 112ha, and as such it comprises less than 1% of the overall SAC. Additionally, although the overall coverage of PVSB within the SAC is listed as 112ha, the four small areas identified within the areas predicted to exceed the screening thresholds were the only areas of PVSB identified during the site surveys carried out in December 2018. This relative rarity of the habitat type within the SAC is a consequence of its habitat requirements for a shingle substrate that is not inundated and without significant quantity of soils within the substrate that would otherwise lead to its characteristic flora being outcompeted by taller more vigorous species such as grasses. As such, the narrow band of suitable conditions within which this habitat occurs is considered to be quite vulnerable to change and was therefore deemed to be prone to adverse nitrogen deposition effects even at a small scale.	
2120 "Shifting dunes along the shoreline with Ammophila arenaria (""white dunes"")"	This habitat is not present within any of the areas predicted to exceed the screening thresholds.	No

Qualifying Feature	Potential Effects	Adverse Effect Before Mitigation? (on conservation objectives and site integrity)
1016 Desmoulin`s whorl snail *Vertigo moulinsiana*	The site supports a small population of the rare Desmoulin's whorl snail in the freshwater fen and brackish reedbeds at the top of the Fishbourne Channel in Chichester Harbour[68]. This species was last recorded within the Solent Maritime SAC in 2005 and no individuals have been found during subsequent surveys in 2009 and 2010. Although the species' broad habitat is sensitive to airborne NH_3, nitrogen deposition and acid deposition, the location of the population and the required habitats are not within the areas predicted to exceed the screening thresholds. Therefore, adverse effects are unlikely for the Desmoulin's whorl snail.	No

[68] English Nature (EN). 2005. EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora: Citation for Special Area of Conservation (SAC) - Solent Maritime [Online]. (accessed 10/10/2019).

3.9.3.4 Assessment summary

Adverse effects (pre-mitigation) at Solent Maritime SAC have been identified for the following qualifying features:

- **1220 Perennial vegetation of stony banks** (nitrogen deposition)

Adverse effects can be discounted for all other qualifying features of the SAC, as well as for acid deposition, NOx and NH_3 as causal pollutants.

3.9.3.5 Mitigation

In previous HRA work for the Solent Maritime SAC[38], it was advocated that a joint Nitrogen Action Plan be developed between Havant Borough Council and Portsmouth City Council in order to mitigate potential negative impacts on PVSB. This Nitrogen Action Plan is currently under development. It is anticipated that a Nitrogen Action Plan will mitigate negative impacts arising from in-combination development from neighbouring local authorities, in addition to development within Havant and Portsmouth.

With the model scenarios available for use in this assessment, it has been impossible to quantify the contribution of development within Fareham, in isolation, to potential adverse impacts on the PVSB located within Langstone Harbour. It will be possible to quantify Fareham's individual contribution with the HRA work planned in support of Fareham's local plan, and it is anticipated that the results of this study will be available in 2020. Depending on the results of that study, and the magnitude of Fareham's contribution to the in-combination impacts on PVSB within Langstone Harbour, it may be appropriate for Fareham Borough Council to join in the development and implementation of the Nitrogen Action Plan. This is an issue which will be revisited and assessed as part of the Fareham local plan HRA study.

Natural England has confirmed that provided Fareham Borough Council has agreed that this issue will be reassessed as part of the local plan HRA, including further discussions with Havant Borough Council and other neighbouring authorities as required, no further comments are raised about this approach.[40]

3.9.3.6 Conclusions

With the application of the mitigation advocated above, adverse effects on the qualifying features (PVSB) of the Solent Maritime SAC can be prevented and as such there will be no threat to the ability of the European site to achieve its conservation objectives or maintain its integrity as a result of the short-term development in Fareham Borough, in combination with short-term development in other local authorities within the PfSH sub-region.

4 Summary of HRA results and conclusions

4.1 Conclusions

For ease of reference, the overall results of the HRA are summarized in the table below.

Table 4-1 Summary of HRA results

Designated Site	Nitrogen deposition	Acid deposition	Airborne NOx	Airborne NH_3
Chichester & Langstone Harbours (Ramsar & SPA)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and existing background levels within the site.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Loads (CLs).	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and the total predicted concentration in 2023.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).
New Forest (Ramsar & SPA)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (after mitigation) can be discounted for all qualifying features, based on existence of a monitoring and mitigation strategy developed in support of the New Forest HRA studies.[48-52] This site will also be revisited during the Fareham Local Plan HRA study.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as APIS specifies that the features are not sensitive due to acidity impacts on broad habitat.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (after mitigation) can be discounted for all qualifying features, based on existence of a monitoring and mitigation strategy developed in support of the New Forest HRA studies.[48-52] This site will also be revisited during the Fareham Local Plan HRA study.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).

Designated Site	Nitrogen deposition	Acid deposition	Airborne NOx	Airborne NH_3
The New Forest (SAC)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (after mitigation) can be discounted for all qualifying features, based on existence of a monitoring and mitigation strategy developed in support of the New Forest HRA studies.[48-52] This site will also be revisited during the Fareham Local Plan HRA study.			
Portsmouth Harbour (Ramsar & SPA)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Loads (CLs).	**Conclusions:** Screened out at HRA Stage 1, as APIS indicates the qualifying features are not sensitive to acid deposition.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and the total predicted concentration in 2023.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).
River Itchen (SAC)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and existing background levels within the site.	**Conclusions:** Screened out at HRA Stage 1, as APIS indicates the qualifying features are not sensitive to acid deposition.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and the total predicted concentration in 2023.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).
Solent & Dorset Coast (pSPA)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the intertidal nature of the areas affected.			

Designated Site	Nitrogen deposition	Acid deposition	Airborne NOx	Airborne NH_3
Solent & Isle of Wight Lagoons (SAC)	**Conclusions:** Screened out at HRA Stage 1			
Solent & Southampton Water (Ramsar & SPA)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and existing background levels within the site.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and existing background levels within the site.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and the total predicted concentration in 2023.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).
Solent Maritime (SAC)	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (after mitigation) can be discounted for all qualifying features, based on development and implementation of a joint Nitrogen Action Plan following the Havant Borough Local Plan HRA.[38] This site will also be revisited during the Fareham Local Plan HRA study.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and existing background levels within the site.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, based on the distribution of qualifying features and the total predicted concentration in 2023.	**Conclusions:** HRA Stage 2 Appropriate Assessment indicates that adverse effects (pre-mitigation) can be discounted for all qualifying features, as the total Predicted Environmental Concentration (PEC) did not exceed the applicable Critical Level (CL).

4.2 Recommendations

Based on the results of this study, we recommend the following:

- **Development in Fareham can take place over the period up to 2023 as set out in this report, with no threat due to emissions to air to the ability of any European site to achieve their conservation objectives or maintain their integrity (either alone or in combination).**

  The conclusion that short-term development in Fareham Borough will not result in adverse effects with regards to NOx concentrations at Chichester and Langstone Harbours Ramsar & SPA, Portsmouth Harbour Ramsar & SPA, River Itchen SAC, Solent and Southampton Water Ramsar & SPA, and Solent Maritime SAC takes account of forecast trends in NOx, as set out in projections carried out by Defra. While there is currently no basis for reasonable scientific doubt in the forecast NOx levels, it is recommended that Fareham maintain a watching brief on the Defra forecasts of future trends in airborne NOx, and that a formal review take place at least once every three years. It would be appropriate for this formal review to take place as part of the programme for wider-ranging review of the Fareham Borough Local Plan HRA.

  Adverse effects from in-combination short-term development within the PfSH region, relating to increased nitrogen deposition to Perennial vegetation of stony banks (PVSB), a qualifying feature of Solent Maritime SAC, cannot be ruled out without mitigation. In order to address the adverse effect of nitrogen deposition identified at Solent Maritime SAC to PVSB, a joint Nitrogen Action Plan is being developed by Havant Borough Council with Portsmouth City Council under the Duty to Co-Operate.

  At the present time Fareham Borough Council is not able to quantify the individual contribution of development within Fareham to the in-combination effects on the Solent Maritime PVSB; this quantification will occur as part of the Fareham Borough Local Plan HRA process.

  Following receipt of the quantification results, Fareham Borough Council may need to work with Havant Borough Council and Portsmouth City Council (and any other relevant local authorities) to further develop and implement the Nitrogen Action Plan on a proportionate basis, to ensure that no adverse effects result from the proposed development in Fareham and neighbouring authorities.

  The existing HRA evidence base for designated sites in the New Forest District Council area (section 3.2.4.5) shows there is already a system in place to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest Ramsar, SPA and SAC.

  At the present time, Fareham Borough Council is not able to quantify the individual contribution of development within Fareham to the in-combination effects on the New Forest Ramsar, SPA and SAC; this quantification will occur as part of the Fareham Borough Local Plan HRA process. It is noted that the New Forest Ramsar, SPA and SAC are some distance outside Fareham Borough's boundaries.

  Following receipt of the quantification results, Fareham Borough Council may need to work with New Forest District Council and the New Forest National Park Authority (and any other relevant local authorities), on a proportionate basis, to identify and mitigate any adverse effects arising from vehicle emissions within the New Forest Ramsar, SPA and SAC.

  Natural England has agreed that the approaches in this HRA are appropriate, providing the issues identified in respect of the Solent Maritime PVSB and the New Forest Ramsar, SPA and SAC are reassessed as part of the local plan HRA.[2]

Appendices

Appendix 1 Air dispersion model verification and adjustment

Appendix 1 - Air dispersion model verification and adjustment

As discussed in Section 2.3.6 this study uses the validated model and hence model adjustment factors calculated during the original PfSH project.[7] This Appendix outlines the methodology used.

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations; this helps to identify how the model is performing and if any adjustments should be applied. The verification process involves checking and refining the model input data to try and reduce uncertainties and produce model outputs that are in better agreement with the monitoring results. This can be followed by adjustment of the modelled results if required. The LAQM.TG(16) guidance recommends making the adjustment to the road contribution of the pollutant only and not the background concentration these are combined with.

The approach outlined in LAQM.TG(16) section 7.508 – 7.534 (also in Box 7.14 and 7.15) has been used in this case. To verify the model, the predicted annual mean Road NOx concentrations were compared with concentrations measured at the various monitoring sites during 2014.

Total measured NOx for each monitoring site was calculated from the measured NO_2 concentration using Version 5.1 of the Defra NOx/NO_2 calculator available from the LAQM website[69], as this is the version of the calculator recommended for the year 2014. The calculator was used for NO_2 measurements from each local authority separately, as it was determined that the air dispersion model provided a better fit for the measured NO_2 data if the general calculator inputs (regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide) were tailored to each local authority individually. Background NOx values for 2014 were obtained from the 2013 reference year background maps available on the LAQM website.

The initial comparison of the modelled vs measured Road NOx identified that the model was under-predicting the Road NOx contribution at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible.

The gradient of the best fit line for the modelled Road NOx contribution vs. measured Road NOx contribution was then determined using linear regression and used as a global/domain wide Road NOx adjustment factor. This factor was then applied to the modelled Road NOx concentration at each discretely modelled receptor point to provide adjusted modelled Road NOx concentrations. A linear regression plot comparing modelled and monitored Road NOx concentrations before and after adjustment is presented in Figure A1-1. A primary NOx adjustment factor (PAdj) of **1.3057** based on model verification using all of the included 2014 NO_2 measurements was applied to all modelled Road NOx data prior to calculating an NO_2 annual mean.

The total annual mean NO_2 concentrations were then determined at points within the model domain using the NOx/NO_2 calculator to combine background and adjusted road contribution concentrations. For this step of the process, regional concentrations of ozone, oxides of nitrogen and nitrogen dioxide were set to those of the local authority where the calibration point was located. The following relationship was determined for conversion of total NOx concentrations to total NO_2 concentrations:

$$(NO_2 \text{ in } \mu g/m^3) = -0.0021(\text{NOx in } \mu g/m^3)^2 + 0.7187(\text{NOx in } \mu g/m^3)$$

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that an RMSE of up to 4 $\mu g/m^3$ is ideal, and an RMSE of up to

[69] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

10 µg/m^3 is acceptable. In this case the RMSE was calculated at 8.6 µg/m^3, which is acceptable, and reasonable for a modelling study over this large a geographical region.

Figure A1-1: Predicted annual average NO_2 concentrations against measured concentrations at monitoring locations. The 30% confidence intervals are also plotted.

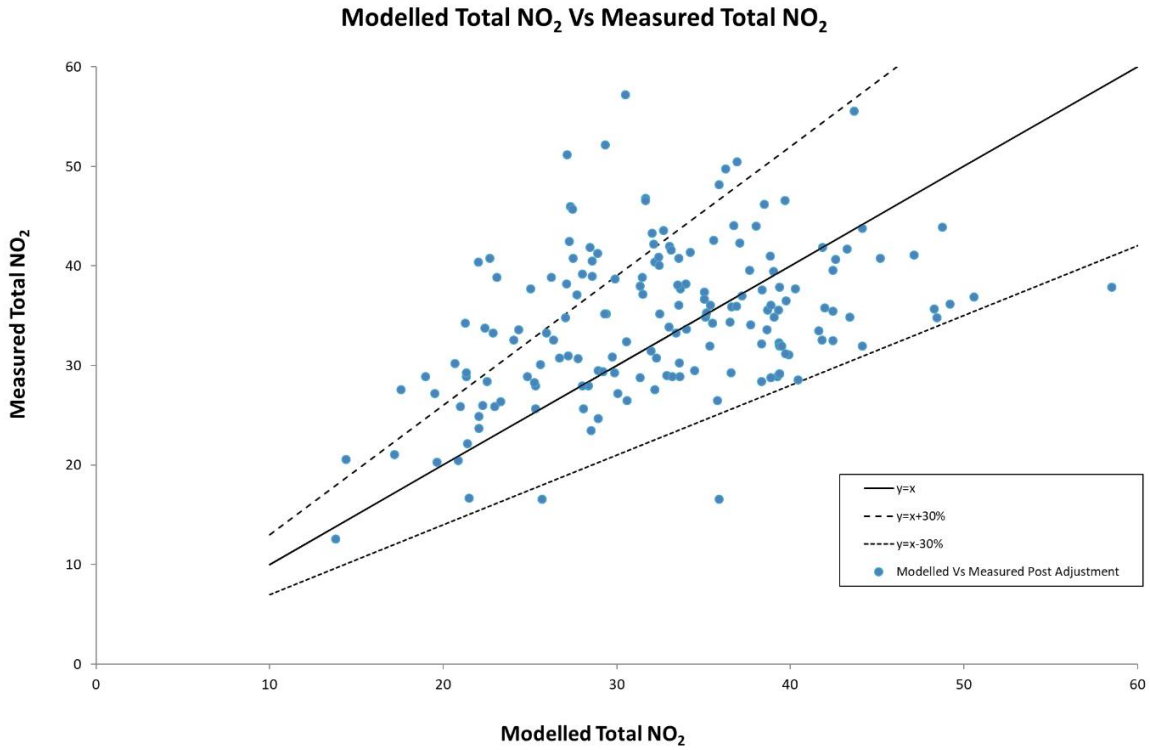


Table A1-1: Modelled and measured NO_2 concentrations for the 2014 reference year and calculated RMSE value

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2014 (µg/m^3)	Modelled NO_2 annual mean concentration 2014 (µg/m^3)
East Hampshire District	EHDC: HR1	470554	113582	33.3	22.9
East Hampshire District	EHDC: HR7	470658	113258	25.9	21.0
Eastleigh Borough	EBC: AL	445908	115544	29.4	29.2
Eastleigh Borough	EBC: AR	443291	122842	12.6	13.8
Eastleigh Borough	EBC: BEL	443778	119303	30.3	33.6
Eastleigh Borough	EBC: BR	446604	119149	38.1	33.5
Eastleigh Borough	EBC: BR2	446051	119171	37.1	27.7
Eastleigh Borough	EBC: CC	443054	118962	32.6	24.0
Eastleigh Borough	EBC: DD	443559	118751	35.7	48.3
Eastleigh Borough	EBC: FOR	447427	118780	25.9	23.0
Eastleigh Borough	EBC: HG	445347	120367	21.1	17.2
Eastleigh Borough	EBC: HL	447717	110359	36.7	35.1
Eastleigh Borough	EBC: HL2	447745	110478	37.7	33.6
Eastleigh Borough	EBC: HSB	451431	113025	40.4	22.0
Eastleigh Borough	EBC: HSB2	451184	113030	33.6	24.3
Eastleigh Borough	EBC: LR13	443842	119527	48.2	35.9
Eastleigh Borough	EBC: MC	444239	120060	31.5	32.0

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2014 ($\mu g/m^3$)	Modelled NO_2 annual mean concentration 2014 ($\mu g/m^3$)
Eastleigh Borough	EBC: MS	445707	119619	36.1	33.6
Eastleigh Borough	EBC: NH	445121	122183	33.7	34.0
Eastleigh Borough	EBC: OX	444543	120187	23.5	28.5
Eastleigh Borough	EBC: PC	444656	120775	32.0	35.4
Eastleigh Borough	EBC: SC	443959	119673	31.0	27.2
Eastleigh Borough	EBC: SR1	445450	118144	51.2	27.1
Eastleigh Borough	EBC: SRAN	445495	118237	42.5	27.3
Eastleigh Borough	EBC: SSQ	443483	118612	31.2	39.7
Eastleigh Borough	EBC: TP	445311	119147	28.3	25.3
Eastleigh Borough	EBC: UNC	448090	112635	29.3	29.9
Eastleigh Borough	EBC: WA	444484	119441	39.2	28.0
Fareham Borough	FBC: BL1	458376	106109	40.8	27.5
Fareham Borough	FBC: DC1	457183	106203	30.1	25.6
Fareham Borough	FBC: E1/2/3	457594	105280	39.6	42.5
Fareham Borough	FBC: FAR1	457594	105280	32.5	42.5
Fareham Borough	FBC: FAR2	457954	106027	46.8	31.7
Fareham Borough	FBC: G10	457675	105616	40.4	32.2
Fareham Borough	FBC: G11	457668	105461	29.0	32.9
Fareham Borough	FBC: G12	457683	105630	42.2	32.1
Fareham Borough	FBC: G14	457631	105494	37.0	37.2
Fareham Borough	FBC: G1A	457726	105627	35.8	42.0
Fareham Borough	FBC: G2A	457627	105138	34.1	37.7
Fareham Borough	FBC: G3	457721	104855	33.6	38.7
Fareham Borough	FBC: G4	457598	105213	32.2	38.3
Fareham Borough	FBC: G6	457599	105410	37.4	35.0
Fareham Borough	FBC: G7	457583	105354	46.2	38.5
Fareham Borough	FBC: G8Z	457656	105049	34.3	35.5
Fareham Borough	FBC: GR/RL	457563	105298	28.6	40.4
Fareham Borough	FBC: HR2	457822	106106	34.3	21.3
Fareham Borough	FBC: HR3A	457787	106140	30.2	20.7
Fareham Borough	FBC: HR4	457857	106076	33.8	22.4
Fareham Borough	FBC: PS1/1A/1B	457939	106012	38.7	29.9
Fareham Borough	FBC: PS2	457937	106021	41.3	28.9
Fareham Borough	FBC: PS3	457935	106033	46.0	27.3
Fareham Borough	FBC: PS4/5/6	457954	106027	46.6	31.7
Fareham Borough	FBC: RM1	455745	107825	29.5	34.5
Gosport Borough	GBC: GOS1	458987	102786	29.5	28.9
Gosport Borough	GBC: GP13	458066	104232	26.5	30.6
Gosport Borough	GBC: GP21	460047	99619	38.9	23.1
Gosport Borough	GBC: GP22	460061	99603	38.2	27.1
Gosport Borough	GBC: GP7	459572	101800	34.4	36.5
Gosport Borough	GBC: GP9/10/11	458987	102786	24.7	28.9

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2014 ($\mu g/m^3$)	Modelled NO_2 annual mean concentration 2014 ($\mu g/m^3$)
Havant Borough	HBC: 13	471988	106076	20.3	19.6
Havant Borough	HBC: 14	471777	106759	27.2	19.5
Havant Borough	HBC: 15	471894	108403	27.6	17.6
Havant Borough	HBC: 18	468264	109415	28.9	19.0
Havant Borough	HBC: 2	471742	105794	16.6	35.9
Havant Borough	HBC: 20	471693	105920	28.9	33.6
Havant Borough	HBC: 21	471589	106132	35.2	32.5
Havant Borough	HBC: 22	471573	106200	30.8	32.3
Havant Borough	HBC: 23	471571	106374	28.8	38.9
Havant Borough	HBC: 25(B)	468479	107721	26.0	30.2
Havant Borough	HBC: 26	467228	107849	40.8	22.7
Havant Borough	HBC: 3	472198	102048	25.7	25.3
Havant Borough	HBC: 4	474866	106425	28.0	25.3
Havant Borough	HBC: 5	471789	106205	28.9	21.3
Havant Borough	HBC: 6(B)	471555	106298	35.3	38.3
Havant Borough	HBC: 7(B)	471180	106063	26.4	35.0
Havant Borough	HBC: 8	467322	107976	28.4	22.5
Havant Borough	HBC: 9(B)	468308	109552	38.9	26.1
Havant Borough	HBC: W10	471368	106805	30.7	27.6
Portsmouth City	PCC: 1	463872	99874	42.6	35.6
Portsmouth City	PCC: 10	467107	104850	16.7	21.5
Portsmouth City	PCC: 11	466869	103457	33.3	25.9
Portsmouth City	PCC: 12	466074	103747	30.9	29.7
Portsmouth City	PCC: 14	466109	103736	27.2	30.0
Portsmouth City	PCC: 15	466120	101324	27.6	32.2
Portsmouth City	PCC: 16	465474	104205	32.3	39.3
Portsmouth City	PCC: 18	466097	101332	28.9	33.2
Portsmouth City	PCC: 19	466392	100226	37.2	31.5
Portsmouth City	PCC: 2	463705	99371	16.6	25.7
Portsmouth City	PCC: 20	466712	99415	28.9	24.8
Portsmouth City	PCC: 21	465209	98964	35.2	29.4
Portsmouth City	PCC: 22	464778	99306	30.8	26.7
Portsmouth City	PCC: 23	464974	99766	28.8	31.3
Portsmouth City	PCC: 24	465111	100737	40.5	28.6
Portsmouth City	PCC: 25	465036	101547	52.2	29.3
Portsmouth City	PCC: 26	464900	101976	40.8	33.6
Portsmouth City	PCC: 3	463408	99460	25.7	28.1
Portsmouth City	PCC: 30	464478	101457	44.1	36.7
Portsmouth City	PCC: 32	464559	100980	34.9	39.1
Portsmouth City	PCC: 34	464425	100893	35.5	42.4
Portsmouth City	PCC: 35	463837	99759	41.4	34.2
Portsmouth City	PCC: 36	464502	99330	34.8	27.0
Portsmouth City	PCC: 4	463190	100390	28.0	28.4

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2014 ($\mu g/m^3$)	Modelled NO_2 annual mean concentration 2014 ($\mu g/m^3$)
Portsmouth City	PCC: 5	464230	102194	28.9	39.3
Portsmouth City	PCC: 6	464331	102197	34.9	43.4
Portsmouth City	PCC: 7	464291	102279	26.5	35.8
Portsmouth City	PCC: 8	466690	104355	28.4	38.3
Portsmouth City	PCC: 9	465621	105528	33.9	33.0
Portsmouth City	PCC: C2	464925	102129	45.7	27.4
Portsmouth City	PCC: C4	465403	103952	22.2	21.4
Portsmouth City	PCC: C6	466004	102348	35.9	36.6
Portsmouth City	PCC: C7	464397	101270	36.5	39.8
Southampton City	SCC: CM1	442583	112248	32.0	39.4
Southampton City	SCC: CM4	442304	112771	41.0	38.8
Southampton City	SCC: CM5	439702	112248	42.0	33.0
Southampton City	SCC: CM6	443751	111121	44.0	38.0
Southampton City	SCC: N100	444386	114450	20.5	20.8
Southampton City	SCC: N101	437543	113726	41.7	43.3
Southampton City	SCC: N102	441678	115278	33.3	33.4
Southampton City	SCC: N103	438805	112902	34.9	35.1
Southampton City	SCC: N104	439218	112850	42.3	37.1
Southampton City	SCC: N106	439754	113982	43.6	32.7
Southampton City	SCC: N107	442367	112896	50.5	36.9
Southampton City	SCC: N109	442585	113248	38.9	31.5
Southampton City	SCC: N110	442583	112248	29.2	39.4
Southampton City	SCC: N111	442583	112248	29.2	39.4
Southampton City	SCC: N112	442583	112248	29.2	39.4
Southampton City	SCC: N113	444122	113292	37.9	58.5
Southampton City	SCC: N114	444131	113326	39.5	39.0
Southampton City	SCC: N115	437939	113473	37.9	39.4
Southampton City	SCC: N116	437951	113407	41.9	41.9
Southampton City	SCC: N118	442472	113068	38.2	34.0
Southampton City	SCC: N120	442555	111021	43.8	44.1
Southampton City	SCC: N122	440000	112633	32.6	41.8
Southampton City	SCC: N123	442351	112302	36.2	49.2
Southampton City	SCC: N124	439741	112746	41.1	47.1
Southampton City	SCC: N125	443126	112645	40.7	42.6
Southampton City	SCC: N126	442369	112283	36.9	50.6
Southampton City	SCC: N129	442555	111021	32.0	44.1
Southampton City	SCC: N130	439346	112822	46.6	39.7
Southampton City	SCC: N131	439379	114185	41.6	33.1
Southampton City	SCC: N133	438608	113018	32.4	30.6
Southampton City	SCC: N134	438969	112863	39.6	37.7
Southampton City	SCC: N135	443714	111052	35.6	38.7
Southampton City	SCC: N136	443731	111053	35.6	39.3
Southampton City	SCC: N137	443990	113340	36.0	36.9

Council	Site ID	Easting	Northing	Measured NO_2 annual mean concentration 2014 (µg/m^3)	Modelled NO_2 annual mean concentration 2014 (µg/m^3)
Southampton City	SCC: N138	441694	115288	49.8	36.3
Southampton City	SCC: N140	441629	112332	55.6	43.7
Southampton City	SCC: N141	441915	110993	43.9	48.8
Southampton City	SCC: N143	439468	114146	40.1	32.4
Southampton City	SCC: N144	443147	112709	33.5	41.6
Southampton City	SCC: N146	443164	112741	31.1	39.9
Southampton City	SCC: N149	441552	115247	36.1	35.4
Southampton City	SCC: N151	439396	114176	40.9	32.4
Southampton City	SCC: N153	437325	113860	37.7	40.3
Southampton City	SCC: N154	442237	111083	40.8	45.2
Southampton City	SCC: N155	442405	111083	36.1	38.9
Southampton City	SCC: N157	442375	110970	34.8	48.4
Southampton City	SCC: N158	443802	111123	37.6	38.4
Southampton City	SCC: N159	443745	111147	29.3	36.6
Southampton City	SCC: N160	442219	112880	32.0	39.5
Southampton City	SCC: N161	442703	114127	35.2	29.3
Southampton City	SCC: N162	442877	114342	41.9	28.5
Southampton City	SCC: N163	442950	114381	32.6	26.3
Southampton City	SCC: N164	442796	114258	39.0	28.6
Southampton City	SCC: N165	442767	114184	57.2	30.5
Southampton City	SCC: N167	439757	114013	38.0	31.3
Southampton City	SCC: N168	439736	114025	43.3	32.0
Test Valley Borough	TVBC: CHIL12	441763	118089	37.7	25.0
Test Valley Borough	TVBC: CHIL13	442137	117670	24.9	22.0
Test Valley Borough	TVBC: CHIL14	442264	117625	28.0	28.0
Winchester City	WCC: Site 5 (District Study)	465917	112050	20.6	14.4
Winchester City	WCC: Site 6 (District Study)	457199	111391	29.3	21.3
Winchester City	WCC: Site 8 (District Study)	453680	108312	23.7	22.0
			RMSE (all sites in this table)		**8.6**

PM_{10} model verification

The model output of Road PM_{10} (the total PM_{10} originating from road traffic) was compared with measured Road PM_{10}, where the measured Road PM_{10} contribution is calculated as the difference between the total measured PM_{10} and the background PM_{10} value.

The initial comparison of the modelled vs measured Road PM_{10} identified that the model was under-predicting the Road PM_{10} contribution at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible.

The gradient of the best fit line for the modelled Road PM_{10} contribution vs. measured Road PM_{10} contribution was then determined using linear regression and used as a global/domain wide Road PM_{10} adjustment factor. This factor was then applied to the modelled Road PM_{10} concentration at each discretely modelled receptor point to provide adjusted modelled Road PM_{10} concentrations. A plot comparing modelled and monitored total PM_{10} concentrations during 2014 is presented in Figure A1-2.

A primary PM_{10} adjustment factor (PAdj) of **3.8962** based on model verification using all of the included 2014 PM_{10} measurements was applied to all modelled Road PM_{10} data prior to calculating an PM_{10} annual mean.

To evaluate the model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted PM_{10} annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). The calculated RMSE is presented in Table A1-2. In this case the RMSE was calculated at **6.5 µg/m^3**.

Limited measurement data was available for the verification of the modelled Road NH_3 data. Using PM_{10} and NOx as an example, the TG16 guidance states that 'in the absence of any PM_{10} data for verification, it may be appropriate to apply the road NOx adjustment to the modelled road-PM_{10}'. In this case, the primary PM_{10} adjustment factor (PAdj) of **3.8962** was applied to all modelled Road NH_3 data prior to calculating the annual mean. The PM_{10} adjustment factor (**3.8962**) was used in preference of that calculated for NOx (**1.3057**) as this represented the worst-case scenario and a more cautious approach when determining the effects of future modelled scenarios.

Figure A1-2: Predicted annual average PM_{10} concentrations against measured concentrations at monitoring locations. The 30% confidence intervals are also plotted.

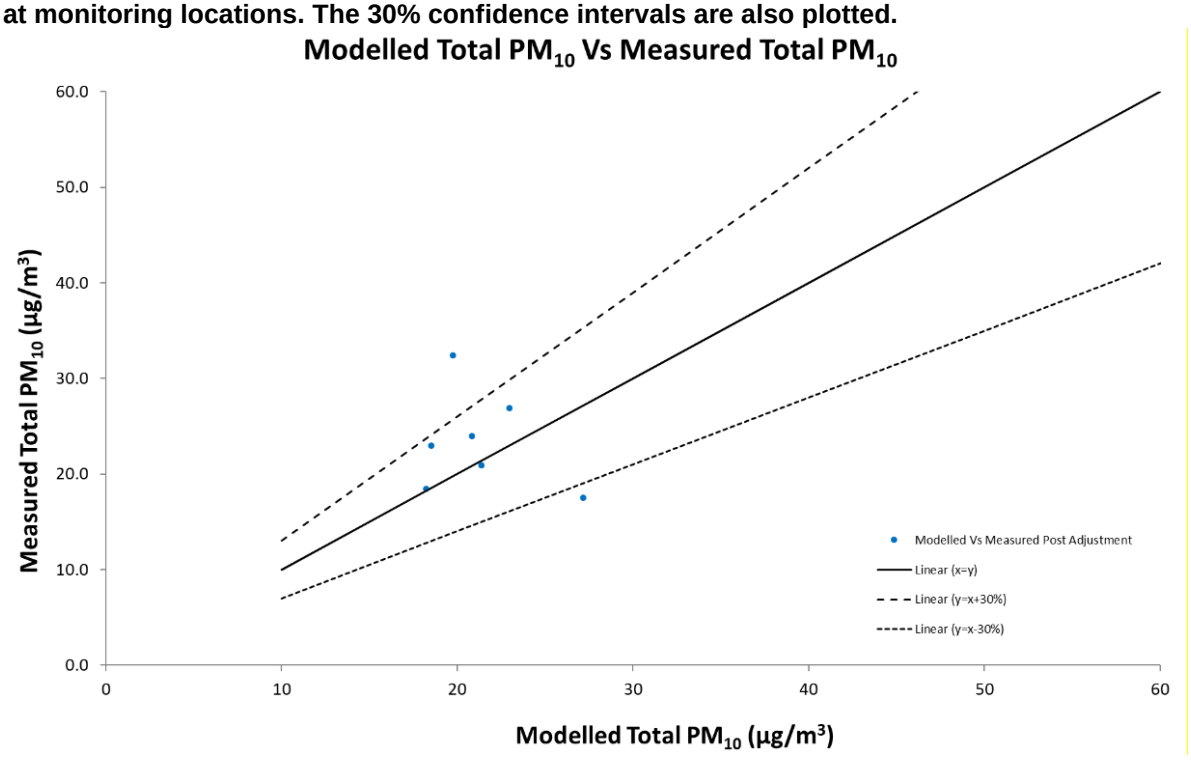


Table A1-2 Modelled and measured PM_{10} concentrations for the 2014 reference year and calculated RMSE value

Council	Site ID	Easting	Northing	Measured PM_{10} annual mean concentration 2014 (µg/m^3)	Modelled PM_{10} annual mean concentration 2014 (µg/m^3)
Portsmouth City	PCC: C2	464925	102129	32.4	19.8
Portsmouth City	PCC: C4	465403	103952	18.5	18.2
Portsmouth City	PCC: C6	466004	102348	26.9	23.0
Portsmouth City	PCC: C7	464397	101270	17.5	27.2
Gosport	GBC: GOS1	458987	102786	24.0	20.8
Southampton City	SCC: CM1	442583	112248	20.9	21.4
				RMSE (all included sites)	**6.5 µg/m^3**

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