Calderdale Council

HABITATS REGULATIONS ASSESSMENT OF THE DRAFT CALDERDALE LOCAL PLAN

Air Quality Assessment

70018699-002
JANUARY 2022

PUBLIC

Calderdale Council

HABITATS REGULATIONS ASSESSMENT OF THE DRAFT CALDERDALE LOCAL PLAN

Air Quality Assessment

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70018699

OUR REF. NO. 70018699-002

DATE: JANUARY 2022

WSP

8 First Street
Manchester
M15 4RP

WSP.com

Calderdale Council

HABITATS REGULATIONS ASSESSMENT OF THE DRAFT CALDERDALE LOCAL PLAN

Air Quality Assessment

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Internal AQ Input Provided to WSP Ecology Specialist	Draft Report with Input from WSP Ecology Specialist	Draft Issue for Client Review	Final Issue
Date	27 January 2021	30 March 2021	27 May 2021	13/01/2022
Prepared by	Stephen Carson	Stephen Carson Stuart Ireland	Stephen Carson Stuart Ireland	Stephen Carson Stuart Ireland
Signature				
Checked by	Damian Pawson	Damian Pawson Caroline McParland	Damian Pawson Caroline McParland	Katie Burrough
Signature				
Authorised by	Damian Pawson	Damian Pawson	Damian Pawson	Damian Pawson
Signature				
Project number	70018699	70018699	70018699	70018699
Report number	v1	v1.1	v1.2	v2

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

CC149d supersedes CC149 (June 2021). CC149d takes account of information exchanged between the Council and Natural England in CC149a and CC149b, and reflects CC149c, the Statement of Common Ground between the Council and Natural England (December 2021). **This document is the subject of the current consultation (January 2022).**

To view all documents published by the Council in relation to the Habitats Regulations Assessment readers may also wish to consult the following references in the Examination Library:

Submission Documents: SD10, SD11 and SD12.1 to SD12.6

Document from the Council: CC118.

Please note these earlier documents do not form part of the current consultation.

WSP was commissioned by Calderdale Council (CC) to complete an air quality assessment to inform the Habitats Regulations Assessment (HRA) for the new Calderdale Local Plan. This report presents the findings of the assessment, which addresses the potential air quality impacts at designated ecological sites associated with changes in traffic flows from the implementation of the Local Plan. The assessment focusses on the South Pennine Moors SAC/SPA designations, which were identified through consultation with Natural England and the HRA screening process as the sites that have the potential to be subject to significant effects arising from the local plan.

The assessment considers vehicle emissions of oxides of nitrogen (NO_x) and ammonia (NH_3) as well as the associated contribution from these emissions to nutrient nitrogen deposition (N-deposition). The South Pennine Moors SAC/SPA is sensitive to changes in each of these.

The changes in NO_x concentrations, NH_3 concentrations, and N-deposition rates within the designated sites were calculated through comparing the outputs of air quality modelling of vehicle emissions for the following scenarios relative to the Calderdale Local Plan assessment year (2032):

- ***2032 With Calderdale Local Plan Only*** *versus* ***2032 Future Baseline***
  - *This provides an assessment of air quality impacts associated with the Calderdale Local Plan 'alone'*
- ***2032 With Calderdale Local Plan plus Bradford Emerging Plan*** *versus* ***2032 Future Baseline***
  - *This provides an assessment of air quality impacts associated with the Calderdale Local Plan 'in-combination' with the Emerging Bradford Local Plan.*

The 2032 Future Baseline scenario incorporated vehicle emissions contributions from traffic associated with the adopted Kirklees Local Plan, the existing Bradford Core Strategy, and the M62 Junction 20-25 Smart Motorways upgrade, which is due to be completed between 2025 and 2030.

The magnitude of changes in NO_x and NH_3 concentrations and N-deposition rates between these scenarios were expressed as a percentage of the relevant assessment benchmarks and appraised against appropriate significance screening criterion, with reference to Natural England guidance.

The air quality modelling demonstrated that the majority of modelled receptors (80%-94%) within the South Pennine Moors SAC/SPA and adjacent to the affected road network are predicted to experience imperceptible changes in NO_x, NH_3, and N-deposition with the Calderdale Local Plan assessed ‘alone’ and ‘in-combination’. The increases in each pollutant that exceed the screening criterion are predicted at 6%-20% of the modelled receptors, occurring adjacent to affected roads including the M62, A672, A640, A58 and B6114.

Examining the Local Plan alone, the area of the South Pennine Moors SAC/South Pennine Moors (Part 2) SPA sites that are subject to increased exceedance of the relevant critical levels and lower critical loads by greater than 1% is **considered to be *de minimis*** and in this case the Local Plan would not have an adverse effect on the integrity of the sites. When **examining the Local Plan in-combination** with the other Bradford Emerging Plan, this conclusion remains unchanged.

Therefore, **it can be concluded on the basis of objective evidence that the Local Plan would not have an adverse effect on the integrity of the South Pennine Moors SAC/South Pennine Moors (Part 2) SPA**.

1. INTRODUCTION

1.1.1. Calderdale Council (CC) is producing a new Local Plan to set the framework for development in the district. Following a consultation on the Local Plan Publication Draft 2018[1], Natural England provided a response, dated 19 September 2018, expressing that insufficient evidence had been submitted within the Local Plan Habitats Regulations Assessment (HRA) with respect to the assessment of traffic emissions on the National Site Network (NSN).

1.1.2. The exclusion of an emissions assessment for the M62 motorway section that runs through the South Pennine Moors Special Area of Conservation (SAC) and South Pennine Moors Phase 2 Special Protection Area (SPA) was of primary concern. Natural England stated that an assessment of air quality impacts associated with the Local Plan on these NSN Sites will be needed.

1.1.3. In 2019, WSP produced a technical note[2] detailing the potential impacts relating to the Calderdale Local Plan on the aforementioned designated sites. Following the submission of that technical note, the CC traffic model for the Local Plan was updated, thus WSP was commissioned by CC to produce a revised air quality assessment for the HRA to consider the potential impacts of the local plan on all designated sites within Calderdale.

1.1.4. In April 2020 WSP submitted a full air quality assessment[3] for the HRA; however, following submission of the air quality assessment there was a further update to the CC traffic model. The updated traffic model has the potential to materially change the results and conclusions of the April 2020 assessment. As such, a full updated, standalone air quality assessment is required, which incorporates the updates to the traffic model.

1.1.5. This report details the approach and outcomes of the revised air quality assessment to feed into the HRA, which has adhered to the proposed scope of work agreed with Natural England via email correspondence dated April 2020[4]. The agreed scope focussed on assessing the impacts of vehicle emissions of oxides of nitrogen (NO_x) and the associated change to nutrient nitrogen (N) deposition rates on the aforementioned South Pennine Moors SAC/SPA. In addition to the agreed scope, this assessment has also considered the potential impact to the SAC/SPA associated with vehicle emissions of ammonia (NH_3), given the availability of published evidence that contributions from combustion engine vehicles are higher than previously estimated.

1.1.6. As part of the scope for the initial technical note[2], Natural England advised that "…*the assessment undertaken by Highways England for the M62 Smart Motorway upgrade project should be taken into account*". At the time of completing this assessment, the M62 Smart Motorway upgrade (Junctions 25-30) is due to commence between January to March 2023 and be operational between 2025 and

[1] Calderdale Local Plan Publication Draft 2018, Published July 2018. https://calderdale-consult.objective.co.uk/portal/planning_services/lpp18/lpp18

[2] WSP Calderdale Local Plan Habitats Regulations Assessment – Air Quality. Technical Note, July 2019

[3] WSP Calderdale Local Plan Habitats Regulations Assessment – Air Quality Assessment, April 2020

[4] Email correspondence with Merlin Ash and Kate Wheeler of Natural England confirming scope of assessment, dated 9th April 2020

2030. In the absence of publicly available traffic data relating to the upgrade, this assessment has included conservative assumptions with respect to the potential increased traffic flows associated with the smart motorways scheme.

1.1.7. Following receipt of Natural England advice (September 2021) this report has been updated to include further information and evidence to support the conclusion drawn.

1.1.8. This report is supported by four appendices:

- Appendix A – Glossary of Terms,
- Appendix B – Legislation & Policy,
- Appendix C – Dispersion Model Approach & Verification,
- Appendix D – Exceedance of 1% Significance Screening Criterion (Core Model Scenarios).

2. LEGISLATION, POLICY & GUIDANCE

2.1. LEGISLATION

2.1.1. Full details of National legislation and the preceding European legislation (where appropriate) are given in **Appendix B**.

2.1.2. The following is a brief summary of the pertinent legislation.

THE CONSERVATION OF HABITATS AND SPECIES REGULATIONS 2017 (AS AMENDED)

2.1.3. The Conservation of Habitats and Species Regulations 2017 (as amended) ('Habitats Regulations'); Regulation 63 (1) states that 'A competent authority, before deciding to undertake, or give any consent, permission, or other authorisation for, a plan or project which—

- (a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and
- (b) is not directly connected with or necessary to the management of that site,

—must make an Appropriate Assessment of the implications for that site in view of that site's conservation objective.'

2.1.4. The Habitats Regulations also make allowance for projects or plans to be completed if they satisfy 'imperative reasons of overriding public interest (IROPI)'[5]. Regulations 64 and 68 relate to such situations.

EU DIRECTIVE ON AMBIENT AIR QUALITY DIRECTIVE (2008/50/EC)

2.1.5. The European Union (EU) Directive on ambient air quality (2008/50/EC)[6] was the primary driver for managing and improving air quality in the UK. The Directive set legally binding limit values for concentrations in ambient (outdoor) air of pollutants, including NO_x and NO_2.

AIR QUALITY REGULATIONS

2.1.6. The EU Directive was transposed into English law through a series of Air Quality Regulations[7,8,9] the most recent being the Air Quality Standards Regulations 2016[10].

---

[5] '*(a) reasons relating to human health, public safety or beneficial consequences of primary importance to the environment; or .*
(b) any other reasons which the competent authority, having due regard to the opinion of the European Commission, consider to be imperative reasons of overriding public interest.'

[6] European Parliament (2008) Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

[7] The Air Quality (England) Regulations 2000 – SI 2000 No.928

[8] The Air Quality (England) (Amendment) Regulations 2002 – SI 2002 No.3043

[9] The Air Quality Standards Regulations 2010 – SI 2010 No.1001

[10] The Air Quality Standards (Amendment) Regulations 2016 – SI 2016 No.1184

UK AIR QUALITY STRATEGY

2.1.7. The UK Government and the devolved administrations are required under the Environment Act 1995 to produce a national air quality strategy. The AQS provides a framework for reducing air pollution in the UK and implements the Air Quality (England) Regulations 2000, setting national objectives for local authorities in England.

2.1.8. The AQS sets standards and objectives for nine key air pollutants to protect human health. In addition, the AQS has set an annual objective for oxides of nitrogen (NO_x) for the protection of vegetation and ecosystems.

2.1.9. The relevant UK standard and objective, and the equivalent EU limit value for NO_x, are given in **Table 1** below.

Table 1 – National Air Quality Objectives/EU Limit Value Set for Protection of Ecosystems

Pollutant	Applied to	Objective	Measured as	Date to be achieved by and maintained thereafter	European Obligations	Date to be achieved by and maintained thereafter
Nitrogen Oxides	UK	30µg/m^3	Annual mean	31/12/2000	30µg/m^3	19/07/2001

2.2. RELEVANT PLANNING POLICY CONTEXT

2.2.1. Full details of relevant planning policies are provided in Appendix B. A summary is provided below.

NATIONAL PLANNING POLICY FRAMEWORK

2.2.2. The Government's overall planning policies for England are described in the National Planning Policy Framework[11]. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

- '… meeting the needs of the present without compromising the ability of future generations to meet their own needs

2.2.3. One of the three overarching objectives of the NPPF is that planning should 'to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.'

2.2.4. It is a matter of Government policy (NPPF paragraph 176) that sites designated under the 1971 Ramsar Convention for their internationally important wetlands (commonly known as Ramsar sites),

[11] Ministry of Housing, Communities and Local Government (February 2019). National Planning Policy Framework

potential SACs (pSACs) and potential SPAs (pSPA) (where consultation has been initiated) are also considered in the same way as SACs, SPAs and cSACs.

2.2.5. For the purposes of this report all relevant sites as described above are collectively termed ‘International Sites’.

2.2.6. In relation to air quality, several paragraphs in the document are relevant and primarily focus on requirements to locate developments sensitively, seek reductions in air pollutants and delivery of sustainable development.

LOCAL PLANNING POLICY

Calderdale Local Plan Publication Draft 2018

2.2.7. The publication draft of the Calderdale Local Plan (2018)[12] includes a number of proposed policies that incorporate consideration of air quality, including Policy EN2 which seeks to ensure air quality matters are appropriately addressed; Policy IM2 which requires air quality to be a factor in transport investment decisions; and Policy GN3 which seeks to limit impacts on designated sites, specifically naming the South Pennine Moors (phase 2) SPA and SAC.

2.2.8. The air quality assessment for the new Local Plan, reported herein, focusses on the potential impacts on designated sites from the change in vehicle emissions associated with the implementation of the Local Plan.

Calderdale Unitary Development Plan

2.2.9. As the new local plan is yet to be finalised, the CC Unitary Development Plan[13] remains the council’s primary planning document. The Development Plan contains Policy EP 1 related to protection of air quality.

2.2.10. In addition, the Unitary Development Plan also contains Policy NE 13 specifically related to designated sites in Calderdale.

---

[12] Calderdale Council (2018) *Calderdale Local Plan Publication Draft 2018* (sourced from website, accessed April 2020: file:///C:/Users/UKDMP601/Downloads/Calderdale_Local_Plan_Publication_Draft_2018_7105887738560017386.pdf)

[13] Calderdale Council Replacement Unitary Development Plan, Adopted 25/08/06, Amended 3/08/09

3. SCOPE & METHODOLOGY

3.1.1. This section provides details of the data and information supplied for the purpose of undertaking the HRA in relation to air quality. It also describes the adopted methodology for assessing and appraising the potential air quality impacts associated with the Local Plan.

3.2. KEY DATA & RESOURCES

3.2.1. Since the submission of the April 2020 air quality assessment[3] there have been various updates to the Defra assessment tools, including:

- Defra's national background pollutant mapping data, with a reference year of 2018,
- Defra's vehicle Emissions Factor Toolkit (EFT) version 10.1, and
- Defra's NO_x to NO_2 calculator version 8.1.

3.2.2. In addition to the above assessment tools, a vehicle emissions toolkit to derive ammonia (NH_3) emissions from vehicle movements has been used. The NH_3 vehicle emissions toolkit is referred to as the CREAM tool (**C**alculator for **R**oad **E**missions of **Am**monia) and was published by Air Quality Consultants in February 2020[14].

3.2.3. An index of the key data and resources used within the assessment is presented in **Table 2**.

Table 2 – Key Data and Resource

Data/Resource	Summary	Source/Reference
Defra national background pollutant mapping data (2018-based)	Background 1km x 1km grid pollutant data obtained for the respective grid squares encompassing the study area	Annual mean data sourced from Defra: *https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018*
Defra EFT v10.1	Vehicle emissions factors toolkit allowing calculation of road link-based pollutant emissions rates (e.g. NO_x) for a specified year, road type, vehicle speed and vehicle fleet composition	https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
Defra Local Air Quality Management (LAQM) Tools	A suite of tools to enable collation of vehicle emissions inventory data and conversion of NO_x to NO_2	All LAQM tools sourced from Defra: *https://laqm.defra.gov.uk/review-and-assessment/tools/tools.html*
Air Quality Consultants CREAM toolkit	Vehicle emissions calculator used to derive NH_3 emissions rates on all modelled road links	Air Quality Consultants (Feb 2020) CREAM calculator V1A[14]

[14] Air Quality Consultants (February 2020) *Ammonia Emissions from Roads for Assessing Impacts on Nitrogen-sensitive Habitats*

Data/Resource	Summary	Source/Reference
Atmospheric dispersion modelling system for roads (ADMS-Roads)	Dispersion model capable of predicting dispersion of emissions from the assessed road network and calculating pollutant concentrations at receptors	ADMS-Roads v5.0 developed by Cambridge Environmental Research Consultants (CERC) Ltd
Baseline and future years traffic data for all model scenarios	Traffic data provided in appropriate format to enable air pollutant emissions inventory (NO_x) databases to be generated prior to dispersion modelling	Data supplied by project transport consultant (WSP). Based on Saturn modelling, accounting for growth from the new Calderdale Local Plan in addition to growth from Kirklees Local Plan, Bradford's existing Core Strategy, and Bradford's Emerging Local Plan, as applicable.
Met Data	Hourly sequential met data obtained from to input to ADMS-Roads model.	Data from Emley Moor monitoring station for year 2019. See **Appendix C**.
LAQM Technical Air Quality Guidance	Guidance document, including information on dispersion modelling and model verification / adjustment	Defra (2016) *Local Air Quality Management Technical Guidance TG16* [15]
Natural England Guidance	Natural England Internal Guidance on assessment of road traffic emissions under the Habitats Regulations	*Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations*[16]
IAQM Guidance	Guidance document for assessing the air quality impact on designated sites	IAQM (2019) *A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites*[17]
Design Manual for Roads and Bridges (DMRB)	DMRB guidance for assessing air quality impacts (sensitive human and designated ecological receptors)	DMRB LA 105 Air Quality[18]
Nitrogen (N) deposition and critical loads	Respective N-deposition rates and empirical habitat critical loads for nutrient nitrogen	Air Pollution Information System (APIS) Website[19]
Designated site information	Site citations including features of interest. Conservation objectives and supplementary advice.	Natural England website[20,21]

[15] Defra (2018) Part IV The Environment Act 1995 and Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management Technical Guidance LAQM.TG16

[16] Natural England (June 2018) Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations (Accessed on 27/11/18 at: http://publications.naturalengland.org.uk/publication/4720542048845824)

[17] IAQM (2019) A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites. Version 1.0 June 2019

[18] DMRB. Highways England, Transport Scotland, Welsh Government and Department for Infrastructure. LA 105 Air Quality

[19] http://www.apis.ac.uk/

[20] http://publications.naturalengland.org.uk/publication/4973604919836672

[21] http://publications.naturalengland.org.uk/publication/4885083764817920

3.3. THE WEALDEN JUDGEMENT

3.3.1. The Wealden Judgement[22], handed down in March 2017, has introduced additional complexities into the HRA process in relation to in-combination and cumulative effects.

3.3.2. Prior to this Judgement, it was deemed that air quality impacts on International Sites need only be considered alongside roads where the traffic growth associated with the individual Plan or Project being assessed exceeded specified screening criteria. These criteria were typically based on changes in vehicle movements and taken from the Design Manual for Roads and Bridges (DMRB, LA105[18]), namely:

- Increases of 1,000 vehicles per day or 200 Heavy Goods Vehicles per day (as Annual Average Daily Traffic (AADT)).

3.3.3. The Wealden Judgement found that the application of the criteria to the traffic growth associated with a single Local Plan was unsound on the basis that two Local Plans collectively contributing more than 1000 AADT could lead to a potentially significant effect. The Judge determined that further assessment of air quality impacts on International Sites should have been carried out and quashed part of the Local Plan that would have led to an in-combination exceedance of 1,000 AADT.

3.3.4. This judgement poses several challenges for Local Authorities and Council Officers, namely:

- Uncertainty – at present, there is no widely accepted approach to the appropriate use of screening criteria and when these may be used to rule out the need for detailed modelling of potential air quality impacts on International Sites. Natural England has published Internal Guidance[16] (albeit published externally), which provides a staged approach for assessing in-combination effects. This methodology has been used as the basis for the air quality assessment,
- Lack of a clear '*de minimis*' – there is case law that supports the use of *de minimus* thresholds in the assessment of potential impacts on International Sites, i.e. where no 'appreciable effect' may occur[23] as the result of a Plan or Project. Some practitioners have argued that Wealden suggests there is no *de minimis* threshold for increases in traffic emissions, and a development leading to an increase of even one vehicle per day should be prohibited or subject to further assessment for in combination traffic growth whilst others have argued that the Wealden judgement applies to the use of traffic thresholds alone,
- Difficulties devising and delivering local planning policy – where predicted Local Plan growth will result in increased vehicle emissions, it is more challenging to determine the appropriate scope of traffic modelling, air quality modelling and HRA work required in support, and
- Difficulties assessing individual planning applications – how do Local Authorities determine planning applications that will increase vehicle movements in proximity to International Sites whilst tracking cumulative growth.

---

[22] Judgment in Wealden District Council v. Secretary of State for Communities and Local Government, Lewes District Council and South Downs National Park Authority [2017] EWHC 351 (Admin) DATE: 21 Mar 2017.

[23] Sweetman v. An Bord Pleanála, Case C-258/11, CJEU judgment 11 April 2013

3.4. NATURAL ENGLAND'S INTERNAL GUIDANCE

3.4.1. In June 2018, Natural England published guidance[16] on their approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations. The document draws upon Annex F of the now superseded DMRB[24] but takes into account the Wealden Judgement and the need to assess 'in-combination' effects on International Sites as a result of air pollution.

3.4.2. The guidance provides a framework around the assessment of road traffic emissions and subsequent effects on International Sites. Notably:

- Step 1 – Does the proposal give rise to emissions which are likely to reach a Habitats Site,
- Step 2 – Are there qualifying features within 200 m of a road sensitive to air pollution,
- Step 3 – Could the sensitive qualifying features of the site be exposed to emissions, and
- Step 4 – Application of the Screening Thresholds.
  - Step 4a: apply the threshold alone,
  - Step 4b: apply the threshold in-combination with emissions from other road traffic plans and projects, and
  - Step 4c: apply the threshold in-combination with emissions from other non-road plans and projects.
- Step 5: Advise on the need for Appropriate Assessment where thresholds are exceeded, either alone or in-combination.

3.4.3. The relevant thresholds in relation to Step 4 are as follows:

- Changes in AADT of 1,000 vehicles a day (or more); and/or
- Changes of 1% of the relevant Critical Load and/or Level as a result of the Plan/Project.

3.4.4. The guidance does not specifically cover nationally significant sites such as Sites of Special Scientific Interest (SSSIs), which are covered by a different regulatory framework. However, it does state that the general principles for air quality assessment outlined for International Sites are likely to be equally relevant for this and other designations.

3.4.5. The above guidance has been referenced throughout the completion of the air quality modelling and assessment, particularly with respect to the scenarios addressed (i.e. Local Plan alone and in-combination with other plans).

3.5. ASSESSMENT METHODOLOGY

INFORMATION TO INFORM AN APPROPRIATE ASSESSMENT

3.5.1. Guidance on the Habitats Directive (European Commission, 2000) sets out the step wise approach which should be followed to enable Competent Authorities to discharge their duties under the Habitats Directive and provides further clarity on the interpretation of Articles 6 (3) and 6 (4). This

[24] DMRB, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 HA 207/07, Air Quality

approach remains appropriate for HRA undertaken under the Habitats Regulations. The process used is usually summarised in four distinct stages of assessment.

- Stage 1: Screening: the process which identifies whether effects upon a Natura 2000 site of a plan or project are possible, either alone or in combination with other plans or projects and considers whether these effects are likely to be significant.
- Stage 2: Appropriate Assessment: the detailed consideration of the effect on the integrity of the Natura 2000 site of the plan or project, either alone or in combination with other plans or projects, with respect to the site's conservation objectives and its structure and function.
- Stage 3: Assessment of alternative solutions: the process which examines alternative ways of achieving the objectives of the plan or project that avoid adverse effects on the integrity of the Natura 2000 site.
- Stage 4: Assessment where no alternative solutions exist and where adverse effects remain: an assessment of whether the development is necessary for IROPI and, if so, of the compensatory measures needed to maintain the overall coherence of the Natura 2000 network.

3.5.2. Following initial screening for the HRA, and consultation with Natural England (Air Quality), this assessment considers the air quality likely significant effects identified in more detail in terms of its nature and extent. The objective of the assessment is to establish whether adverse effects on the integrity of internationally designated sites can be ruled out, taking into account mitigation measures and the potential for further in-combination effects that may arise from other plans or projects.

3.5.3. The precautionary principle is applied at all stages of the HRA process. In relation to screening this means that projects or plans where effects are considered likely and those where uncertainty exists as to whether effects are likely to be significant must be subject to the second stage of the HRA process, Appropriate Assessment.

3.5.4. The use of the term Favourable Conservation Status (FCS) is not amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and the term still has the meaning given by Article 1 of the Habitats Directive. Defra (2021) does however note that "*an appropriate authority is only responsible for managing and adapting the national site network to secure FCS of a feature proportionately to the importance of the UK within the feature's natural range*". The Habitats Directive provides further interpretation of the meaning of 'favourable conservation status' within Article 1 parts a, e and i as below.

'(a) conservation means a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status as defined in (e) and (i);…..

(e) conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2. The conservative status of a natural habitat will be taken as "favourable" when:

- *its natural range and areas it covers within that range are stable or increasing, and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and*
- *the conservation status of its typical species is favourable as defined in (i);*

(i) conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2; The conservation status will be taken as "favourable" when:

- *- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and*
- *- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and*

3.5.5. *- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis'.*

3.5.6. The following steps have been incorporated into the assessment:

- Gathering additional information on, and exploring the reasons for, the relevant International Sites,
- Determining the nature of the environmental conditions required to maintain the integrity of the International Sites and the trends in associated environmental processes (the Conservation Objectives),
- Identifying whether the Proposed Scheme could lead to an impact on any identified processes that support the International Sites,
- Determining whether the identified impact could result in an adverse effect on the integrity of International Sites,
- Identifying other plans and projects that might affect these International Sites in-combination and establishing whether there are any adverse in-combination effects on integrity, and
- Developing mechanisms to enable the delivery of measures to avoid or mitigate for any identified potential effects.

STUDY AREA

3.5.7. The study area for the air quality assessment was determined through identifying the road links (Calderdale Saturn traffic model outputs aligned to real-world road network) within 200 m of the relevant designated sites in Calderdale (**Figure 1**). However, further screening of the data using the DMRB criteria[18] (as per Natural England guidance[16]) was not completed, which conservatively ensures that all road emissions sources within 200 m of a designated site from the SATURN traffic model were included in the air quality model.

3.5.8. This modelled road network is referred to as the Affected Road Network (ARN) and it was used to determine where discrete receptor transects would be modelled within the assessed South Pennine Moors SAC/SPA, in addition to assigning a Cartesian receptor grid to encompass a minimum distance of 500 m from the ARN. (see **Section 4.3**).

3.5.9. The extent of the study area is shown in **Figure 1**.

BACKGROUND AIR QUALITY

3.5.10. Background air pollutant (NO_x, NO_2) concentrations for the baseline year (2019) and future year (2030) were obtained for the corresponding 1 km^2 grid squares covering the study area from Defra's published national pollutant mapping data (2018-reference year).

3.5.11. Background NH_3 concentrations and rates of nitrogen (N) deposition corresponding to the relevant habitats within the NSN were sourced from site-specific data available from APIS[19].

ATMOSPHERIC DISPERSION MODELLING

3.5.12. The air quality modelling focussed on the following scenarios, for which traffic data were provided to facilitate dispersion modelling of vehicle emissions using CERC's ADMS-Roads v5.0 model:

- **2019 Baseline & Model Verification,**
- **2032 Future Baseline** (*excluding Calderdale Local Plan but including the adopted Kirklees Local Plan, existing Bradford Core Strategy and M62 smart motorways project, with 2030 emissions factors and 2030 pollutant backgrounds applied*[25]*),*
- **2032 With Calderdale Local Plan Only** *(Future Baseline scenario plus Calderdale Local Plan, with 2030 vehicle emissions factors and 2030 backgrounds applied)*, and
- **2032 With Calderdale Local Plan *plus* Bradford Emerging Plan** (*Future Baseline scenario with Bradford Core Strategy removed and replaced by Bradford Emerging Plan, including Calderdale Local Plan, with 2030 vehicle emissions factors and 2030 backgrounds applied*).

3.5.13. Traffic data were provided by the project transport consultants (WSP) based on SATURN outputs for the whole of Calderdale and screened to establish the ARN (*see paragraph 3.5.7*). The traffic data used in the assessment comprised the Annual Average Daily Traffic (AADT) flows, vehicle speeds (km/h) and the percentage of Heavy Duty Vehicles (HDVs) applicable to the ARN in all assessment years[26].

M62 Junctions 25-30 Smart Motorways Project

3.5.14. The SATURN model did not incorporate the changes in traffic flows associated with the proposed M62 Smart Motorways project (M62 junction 25 to 30), given that traffic data for the project were not available in the public domain at the time of assessment. A 7% growth factor was adopted subsequent to reviewing the observed changes in traffic flows associated with the M62 Junction 26-27[27] and the M1 Junctions 25-28[28] Smart Motorway projects.

3.5.15. The main findings from reviewing these schemes were:

- **M62 J26-27** – Post opening, the weekday flows are between 0% and 7% higher compared with that observed before construction (2011), which is in line with the background level of traffic growth.
- **M1 J25-28** – Overall, traffic flows across the scheme extent have shown a negligible change. Average weekday traffic travelling northbound has seen an average of 1% change from pre-

[25] Defra EFT v10.1 provides vehicle emissions factors for years 2018-2030 inclusive. Therefore, 2030 vehicle emissions factors were applied to represent the assessment year (2032)

[26] Due to the size of the traffic model output datasets used in the air quality assessment, the data are not reported within this document. However, a full traffic data set can be provided on request.

[27] Highways England (April 2016) *Post Opening Project Evaluation: M62 J25-30 Smart Motorway - One Year After*

[28] Highways England (May 2017) *M1 Junction 25 to 28 Widening - Five Years After Opening Evaluation*

scheme to five years after the scheme was implemented. Southbound has seen no change, on average, in traffic flow.

3.5.16. Minimal changes in overall traffic volumes were observed as a result of the respective smart motorway schemes, with changes mirroring those seen on other roads (i.e. background growth).

3.5.17. However, a growth factor of 7% was applied to all relevant motorway links within the above scenarios, which is considered to represent an appropriately conservative approach based on the review of above Smart Motorway schemes.

3.5.18. Given that the M62 Smart Motorways project is due to be completed between 2025 and 2030, the assumed traffic growth associated with it was applied to all future 2032 scenarios.

Vehicle Emissions Inventories

3.5.19. The traffic data were used to develop NO_x and NH_3 emissions inventory databases for each scenario using the Defra EFT version 10.1[29] and CREAM V1a[14], respectively. These accounted for traffic flow characteristics, including:

- Road type (e.g. urban, rural, motorway),
- Total vehicle flow by link (AADT),
- Percentage of HDVs per link, and
- Average link speed (km/h) – *EFT v10.1 only, CREAM emissions factors (NH_3) not speed dependent*.

3.5.20. The emissions database outputs for each respective scenario provided road link-specific pollutant emission rates (g/km/s), which were input to the ADMS-Roads model to enable prediction of road-NO_x and road-NH_3 concentrations at identified sensitive receptor locations. In addition, the following model inputs were required:

- Geometry of each affected road link, and
- Hourly sequential meteorological data obtained from Emley Moor for 2019.

Model Verification

3.5.21. Verification of the ADMS-Roads model outputs was undertaken through comparing the annual mean NO_2 base year (2019) model outputs with local monitoring data from CC. This enabled appropriate model adjustment factors, derived with reference to LAQM.TG16, to be applied to model outputs to ensure the performance of the dispersion model was acceptable within the context of the available monitoring data. Further details of the modelling process, input data and the model verification and adjustment procedure are presented in **Appendix C**.

[29] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

3.6. ASSESSMENT OF ADVERSE EFFECTS

3.6.1. The results of the atmospheric dispersion modelling at each identified ecological receptor have been compared to the assessment benchmarks, as specified in **Table 5** of **Section 4.3**, to evaluate the potential for exceedances in all scenarios.

3.6.2. The magnitude of change for predicted NO_x and NH_3 concentrations and N-deposition at each receptor, as a result of the Calderdale Local Plan implementation, has been derived through comparing the following scenarios for the future assessment year (2032):

- ***2032 With Calderdale Local Plan Only*** versus ***2032 Future Baseline***
  - This provides an assessment of air quality impacts associated with the **Calderdale Local Plan alone**
- ***2032 With Calderdale Local Plan plus Bradford Emerging Plan*** versus ***2032 Future Baseline***
  - This provides an assessment of air quality impacts associated with the **Calderdale Local Plan in-combination** with the Emerging Bradford Local Plan.

3.6.3. The magnitude of change is expressed as a percentage of the respective environmental benchmark for annual mean NO_x (30 µg/m^3), annual mean NH_3 (1 µg/m^3), and the lowest value of the relevant critical load range for N-deposition (5 kgN/ha/yr). With reference to Natural England guidance[16], where the change in concentration/deposition exceeds 1% of the relevant environmental benchmark, the potential for significant effects on the sensitive feature(s) to occur cannot be ruled out. Below the 1% screening threshold, the impacts can be treated as imperceptible, resulting in no significant effects.

3.6.4. If the assessment results predict that the 1% significance screening criterion is exceeded at any sensitive feature, the results of the air quality assessment are analysed by a suitably qualified ecologist to determine if the predicted change in NO_x/NH_3 concentration and/or N-deposition at the sensitive feature constitutes a significant effect.

3.6.5. To further assist the analysis by the qualified ecologist specifically in relation to N-deposition, the results of the assessment are also presented within the context of DMRB LA105[18] guidance, which states that "…*If the change in N deposition is greater than 0.4 kgN/ha/yr for the project, the competent expert for biodiversity shall review the air quality attribute target for the site to confirm whether it is restore or maintain and update the assessment if necessary*." As such, all receptors predicted to experience an increase in N-deposition in excess of 0.4 kgN/ha/yr are presented separately.

3.6.6. Where the change in nitrogen deposition is greater than the LA 105 designated habitat screening criteria, LA 105 prescribes a need to identify whether the designated habitat air quality attribute is either 'Restore' or 'Maintain'. Air quality attributes are publicly specified for European designated sites[30] (those protected at an international and European level). In the case of the South Pennine Moors SAC and SPA, the attribute should be taken as 'Restore' as the sites are currently in

[30] Outlined in the European Site Conservation Objectives for each site.

exceedance of the lower critical load for N-deposition of 5 kgN/ha/yr (based on the most sensitive habitat present within the designation) (see **Error! Reference source not found. and** Error! Reference source not found.).

3.6.7. A series of isopleth[31] maps have been produced which show the Habitats of Principle Importance (HPI)[32] contained within the South Pennine Moors SAC/SPA (Figure 9a & 9b).

3.6.8. For each of the potential pollutants examined within this report (NO_x (Figure 10a-e), NH_3 (Figure 11a-e) and N-deposition (Figure 12a-e)) a series of isopleth figures has been produced illustrating the following:

- Figure a – Future Baseline
- Figure b – Local Plan Alone
- Figure c – In-combination
- Figure d – Change – Local Plan Alone
- Figure e – Change – In-combination

3.6.9. These figures are extracts of the model, concentrated on the areas of the SAC/SPA which will be subject to increases in the pollutants stated above. This mapping allows a clear representation of the pollutant contribution arising from the Local Plan, both alone and in-combination with other plans or projects. For clarity, those areas of the SAC/SPA not shown will not be subject to any change from a contribution arising as a result of the Local Plan.

3.7. LIMITATIONS & ASSUMPTIONS

3.7.1. There are uncertainties associated with both measured and predicted concentrations of airborne pollutants. The model (ADMS-Roads) used in this assessment relies on input data (including predicted traffic flows), which are subject to uncertainty. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS-Roads model will not take into account.

3.7.2. In order to reduce the uncertainty associated with predicted concentrations, model verification has been carried out with reference to guidance set out in LAQM.TG16[15] (see **Appendix C** for details). As the model has been verified against local authority monitoring data and adjusted accordingly, there can be reasonable confidence in the predicted concentrations. The root mean square error (i.e. average model error) of the verified model is within the ideal range given by LAQM.TG16 (see **Appendix C**).

3.7.3. The additional influence of the M62 Junctions 25-30 Smart Motorway project on air quality has been represented based on an assumed 7% uplift on total vehicle flows, which will occur in each of the future year (2032) scenarios on the respective road links. This represents an upper estimate of potential increased flows within the context of the review completed for similar operational smart

[31] Lines joining points of equal pollutant concentration/deposition value.

[32] Data sourced from www.magic.gov.uk in November 2021.

motorway schemes, where the observed uplift in traffic ranged from 0% to 7% after 1-5 years following scheme opening (*see paragraph 3.5.14*).

3.7.4. Vehicle emissions of NO_x have been derived using Defra's EFT v10.1 emissions factors, which represent the latest version of the EFT at the time of completing this assessment. A study completed by Air Quality Consultants comparing EFT v10.1 to the previous version (v9.0)[33] concluded that there is "…*no justification for the use of sensitivity tests assuming higher NO_x emissions in the future than EFT v10 predicts*". This is because "…*the EFT may be relied upon to predict the most likely, or potentially conservative, situation in the future, provided that the assessment is verified against measurements made in the year 2016 or later*". For years post-2016, the study found that the EFT is likely to under-predict the rate of reduction (i.e. improvement) in vehicle NO_x emissions. Given that the air quality modelling reported in this assessment was verified against measurements made in 2019, no sensitivity testing was deemed required with respect to future emissions factors.

3.7.5. Given the variation in existing NH_3 concentrations and N-deposition rates across the identified sensitive features within the designated sites, the highest annual average concentration and deposition rate were used to be representative of all features based on the modelled receptors. Similarly, the adopted environmental benchmarks for ammonia concentrations and N-deposition rates are based on the lowest critical level and critical load, respectively, given across all identified sensitive habitats included in the assessment (1 $\mu g/m^3$ for NH_3 and 5 kgN/ha/yr for N-deposition, as per **Table 5**).

3.7.6. With respect to the inclusion of NH_3 emissions in this assessment, there is, at present, no consensus on best practice for the consideration of ammonia in relation to vehicle emissions. There are, in comparison to the evidence base around nitrogen oxides, relatively few measurements of roadside ammonia concentrations and vehicle emissions. However, the evidence that is available supports a conclusion that the impacts on roadside nitrogen deposition from ammonia are at least of a similar magnitude to that from nitrogen oxides[14].

3.7.7. The key features of the CREAM calculator are that:

1. Petrol vehicles emit significantly more ammonia than diesel vehicles; and
2. Emissions from petrol vehicles are not expected to improve over time.

3.7.8. The first feature arises from observation of vehicle emissions using remote sensing. The second is a precautionary position, based on uncertainty over the performance of 3-way catalysts as Euro 5 and 6 vehicles age and uncertainty in relation to emissions from hybrid petrol vehicles. Therefore, the CREAM tool is conservative with respect to deriving ammonia emissions from vehicles in future years (e.g. 2030 in this assessment), by which time emissions from vehicles would be expected to have improved with a shift towards zero emission vehicles.

---

[33] Air Quality Consultants (September 2020) *Comparison of EFT v10 with EFT v9*

4. DESIGNATED SITES

4.1. SOUTH PENNINE MOORS SAC

Reasons for Designation

4.1.1. The South Pennine Moors SAC is designated for the following Annex 1 habitats:

- European dry heaths
- Blanket Bogs[34]
- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

4.1.2. In addition, the following Annex 1 habitats are present as qualifying features, but not as primary reasons for selection of the SAC:

- Northern Atlantic wet heaths with *Erica tetralix*
- Transition mires and quaking bogs

4.1.3. No Annex 2 species are primary or qualifying features of the SAC.

Conservation Objectives

4.1.4. Natural England published a Conservation Objective document for the SAC in 2018, this document states:

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

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

4.1.5. The Conservation Objectives (2018) document is supplemented by the Supplementary advice on conserving and restoring site features document (Natural England, 2019). The supplementary advice in relation to Air Quality has been extracted from Tables 1 to 5 of the Natural England document, and is presented in **Table 3.**

[34] Active blanket bog is a Priority feature

Table 3 - Natural England Air Quality supplementary advice in relation to the South Pennine Moors SAC.

Habitat	Targets	Supporting and Explanatory Notes	Source of site-based evidence (where available)
H4010. Northern Atlantic wet heaths with *Erica tetralix;* Wet heathland with cross-leaved heath.	Restore as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk). As a staged recovery the target for South Pennine Moors SAC should be to transition to the next lower class of critical load exceedance i.e., for Acidity reduce deposition to 0.5-1.0 keq/ha/yr and for nutrient Nitrogen reduce deposition to between 7-14 kgN/ha/yr	This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH_3), oxides of nitrogen (NO_x) and sulphur dioxide (SO_2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of seminatural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales. Atmospheric pollution over the last few hundred years has depleted the lichen and bryophyte flora and may be affecting dwarf-shrubs.	More information about site relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). JNCC.2011. UK SAC data form – South Pennine Moors SAC. Available from Natural England - http://uk-air.defra.gov.uk/data CEH. Trends in critical load exceedance in UK – Report to DEFRA
H4030. European dry heaths.	As above.	As above. Nitrogen deposition currently (2014) exceeds site relevant critical loads.	More information about site relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). Natural England. 2014. South Pennine Moors SAC Site Improvement Plan. (http://publications.naturalengland.org.uk /category/4526209115357184)

Habitat	Targets	Supporting and Explanatory Notes	Source of site-based evidence (where available)
			CEH. 2015. Trends in critical load exceedance in UK - report to Defra
H7130. Blanket bogs. *	As above.	As above. Atmospheric pollution from the last few hundred years has depleted the lichen and bryophyte flora and may be affecting dwarf-shrubs. Further, on site Nitrogen deposition is exceeding site critical loads.	More information about site relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). JNCC.2011. UK SAC data form – South Pennine Moors SAC. Available from Natural England http://uk-air.defra.gov.uk/data CEH. 2015. Trends in critical load exceedance in UK, CEH report to Defra
H7140. Transition mires and quaking bogs; Very wet mires often identified by an unstable 'quaking' surface.	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	As above. Atmospheric pollution over the last few hundred years has depleted the lichen and bryophyte flora and may be affecting dwarf-shrubs. The impact has arguably been greatest on blanket bog, wet heath, and transition mire where the bog-building Sphagnum mosses have been largely lost.	More information about site relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). JNCC.2011. UK SAC data form – South Pennine Moors SAC. Available from Natural England. Natural England. 2014. South Pennine Moors SAC Site Improvement Plan. (http://publications.naturalengland.org.uk /category/4526209115357184)
H914A0. Old sessile oak woods with Ilex and Blechnum in the British Isles.	As above.	As above. Atmospheric pollution over the last few hundred years has depleted the lichen and bryophyte flora and may be affecting woodland ground flora. Currently nitrogen deposition is also still exceeding site relevant critical loads for certain soil types.	More information about site relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). JNCC.2011. UK SAC data form – South Pennine Moors SAC. Available from Natural England.

Habitat	Targets	Supporting and Explanatory Notes	Source of site-based evidence (where available)
			Natural England. 2014. South Pennine Moors SAC Site Improvement Plan. (http://publications.naturalengland.org.uk /category/4526209115357184)

4.2. SOUTH PENNINE MOORS SPA

Reasons for Designation

4.2.1. The South Pennine Moors (Phase 2) SPA is designated for breeding short-eared owl *Asio flammeus,* merlin *Falco columbarius, and* golden plover *Pluvialis apricaria*.

4.2.2. In addition, the site is recognised for the important breeding bird assemblage it supports.

Conservation Objectives

4.2.3. Natural England published a Conservation Objective document for the SPA in 2019, this document states:

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

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.

4.2.4. The Conservation Objectives (2019) document is supplemented by the Supplementary advice on conserving and restoring site features document (Natural England, 2018). The supplementary advice in relation to Air Quality has been extracted from Tables 1 to 3 of the Natural England document, and is presented in **Table 4.**

Table 4 - Natural England Air Quality supplementary advice in relation to the South Pennine Moors (Phase 2) SPA.

Feature	Attribute	Targets	Supporting and Explanatory Notes	Source of site-based evidence (where available)
A908 *Falco columbarius*; Merlin (breeding).	Supporting habitat (both within and outside the SPA): function/supporting process.	Restore as necessary the concentrations and deposition of air pollutants to below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	The structure and function of the habitats which support this SPA feature may be sensitive to changes in air quality. Exceeding critical values for air pollutants may result in changes to the chemical status of a supporting habitats' substrate, accelerating or damaging plant growth, altering vegetation structure and composition and thereby affecting the quality and availability of nesting, feeding or roosting habitats. Critical Loads and Levels are thresholds below which such harmful effects on sensitive UK habitats will not occur to a noteworthy level, according to current levels of scientific understanding. There are critical levels for ammonia (NH_3), oxides of nitrogen (NO_x) and sulphur dioxide (SO_2), and critical loads for nutrient nitrogen deposition and acid deposition. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. The critical values for the supporting habitats of the SPAs are currently being exceeded (November 2018).	More information about site-relevant Critical Loads and Levels for this SPA is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
A140 *Pluvialis apricaria; Golden plover (breeding)*.	As above.	As above.	As above.	As above.
Internationally important breeding bird assemblage.	N/A	N/A	N/A	N/A

4.3. IDENTIFIED RECEPTORS & ENVIRONMENTAL BENCHMARKS

4.3.1. The South Pennine Moors has overlapping designations as a SAC and SPA, being the only designated sites that are located within 200 m of an affected road link and thus form the focus of this assessment. The South Pennine Moors covers a large area and is split into two main locations (north and south), as shown in **Figure 1**.

4.3.2. The background annual mean NO_x concentrations (Defra), annual mean NH_3 concentrations (APIS), and annual N-deposition rates (APIS) and respective critical loads for nutrient nitrogen (where available) are included in **Table 5** for each sensitive habitat within the International Sites.

4.3.3. Following the precautionary principal, the assessments have been undertaken with reference to the lower critical load or level to ensure the potential effects are considered fully.

4.3.4. The data show that the lower critical load for N-deposition is exceeded by the average background N-deposition at every single feature. The upper critical load range is also exceeded at the majority of features except for those that have an upper critical load of 30 kg N/ha/yr.

4.3.5. The baseline average annual mean background NO_x levels applicable to each designated site are well below the UK annual mean objective. However, the maximum annual average NH_3 concentrations throughout the study area are reported to exceed the critical level for the most sensitive habitats (1 $\mu g/m^3$).

4.3.6. A total of 28(no.) discrete receptor transects were selected to represent locations within the sensitive International Sites. The transects start at the International Site boundary, closest to the modelled roadside, with receptor points spaced at 10 m intervals up to 200 m from the roadside.

4.3.7. Of the 28(no.) transects, 6(no.) are adjacent to the M62 (transects 1, 2, 3, 4, 7 and 8), with all remaining transects adjacent to ‘A’ roads, ‘B’ roads and minor roads. An overall location plan for the designated sites, including the transects, is shown in **Figure 1**.

4.3.8. The road source contributions to annual mean NO_x and NH_3 concentrations at each transect receptor point were predicted using the ADMS-Roads model. The road source contributions were combined with the respective background NO_x / NH_3 data to generate total contributions.

4.3.9. N-deposition rates were derived for each applicable designated site with reference to the air quality technical guidance published by the Environment Agency[35]. This guidance provides recommended dry deposition velocities for NO_2 and NH_3 based on ‘grassland’ or ‘forest’ land use/habitat types. Given that over 95% of the South Pennine Moors SAC/SPA area is covered with short vegetation and grassland habitats such as bogs, marshes, dry/humid grassland, heath, scrub etc., a dry deposition velocity equivalent to ‘grassland’ was adopted for the air quality modelling.

4.3.10. Modelled road contributions to NO_x concentrations at each receptor were converted to modelled road NO_2 contributions using the Defra NO_x to NO_2 calculator (v8.1), then both NO_2 and NH_3 road

[35] Environment Agency (2014) AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air

contributions were converted to dry N-deposition rates using specific conversion factors, as detailed below:

- Grassland and similar habitats:
  - 1 $\mu g/m^3$ of NO_2 = 0.14 kg N/ha/yr
  - 1 $\mu g/m^3$ of NH_3 = 5.19 kg N/ha/yr

4.3.11. The dry N-deposition rates from modelled road sources were subsequently added to the maximum average background deposition (26.6 kg N/ha/yr as detailed in **Table 5**) to derive the total annual N-deposition rate.

4.3.12. The relevant environmental benchmarks adopted for the air quality assessment equate to:

- the UK air quality objective and EU limit value for annual mean NO_x (30 $\mu g/m^3$),
- the lowest critical level value for NH_3 (1 $\mu g/m^3$),
- and the lowest critical load value with respect to N-deposition (5 kgN/ha/yr), based on all sensitive features identified in **Table 5**.

4.3.13. In addition to modelling discrete receptor transects, a 200 m x 200 m resolution Cartesian receptor grid was modelled within a minimum distance of 500 m from the ARN to ensure that all potential impacts above the 1% significance screening criterion (see **Section 3.6**) within the International Site boundary were captured. The modelled grid area is depicted in **Figure 11**.

4.3.14. The outputs from the grid modelling for each scenario and pollutant were used to calculate the area of the designated site that exceeds the 1% criterion, where applicable. In addition to the discrete transect receptor results, the gridded results enabled the suitably qualified ecologist to provide an assessment of significance.

4.3.15. In addition, as discussed in paragraphs **3.6.5** to Error! Reference source not found., the results of both the transect and receptor grid modelling have been used to facilitate an assessment following guidance provided in LA105[18] with respect to N-deposition.

Table 5 – Sensitive Habitats relevant to South Pennine Moors SPA/SAC designated sites within 200m of Affected Road Network

<table>
<tr><th>Site</th><th>Designation</th><th>Sensitive Features</th><th>2019 Average Background NO_x ($\mu g/m^3$)</th><th>Average Background NH_3 ($\mu g/m^3$)*</th><th>Average Background N-Deposition (kgN/ha/yr)*^</th><th>N-deposition Critical Load Range (kgN/ha/yr)</th></tr>
<tr><td rowspan="6">South Pennine Moors Phase 2</td><td rowspan="6">SPA</td><td>Raised & blanket bogs</td><td rowspan="6">11.0</td><td rowspan="6">1.5</td><td rowspan="6">26.6</td><td rowspan="2">5-10</td></tr>
<tr><td>Moss & lichen dominated mountain summits</td></tr>
<tr><td>Northern wet heath: Calluna-dominated wet heath</td><td rowspan="2">10-20</td></tr>
<tr><td>Dry heaths</td></tr>
<tr><td>Pioneer, low-mid, mid-upper saltmarshes</td><td rowspan="2">20-30</td></tr>
<tr><td>Low & medium altitude hay meadows</td></tr>
<tr><td rowspan="5">South Pennine Moors</td><td rowspan="5">SAC</td><td>Raised & blanket bogs</td><td rowspan="5">11.0</td><td rowspan="5">1.5</td><td rowspan="5">26.6</td><td>5-10</td></tr>
<tr><td>Old sessile oak woods with Ilex and Belchnum in the British Isles</td><td rowspan="2">10-15</td></tr>
<tr><td>Valley mires, poor fens & transition mires</td></tr>
<tr><td>Dry heaths</td><td rowspan="2">10-20</td></tr>
<tr><td>Northern wet heath: Erica tetralix dominated wet heath</td></tr>
<tr><td colspan="3">Adopted Assessment Benchmarks</td><td>30 $\mu g/m^3$</td><td>1 $\mu g/m^3$</td><td colspan="2">5 kgN/ha/yr</td></tr>
</table>

* Based on 3 year mean 2017-2019 (APIS[19] location-specific tool based on modelled transect coordinates), with maximum average value used in assessment
^ Background N-deposition rate not reduced for the future assessment year (2032), which is in line with the current IAQM[14] and DMRB guidance[15]

5. RESULTS

5.1.1. An assessment of changes in air quality at the designated sites was undertaken with reference to Natural England[16] guidance. A summary of the results at receptors with a magnitude of change of 1% and above the assessment benchmarks for NO_x, NH_3, and/or N-deposition, equating to an exceedance of the significance screening criterion, is provided in this section.

5.1.2. The locations of receptors that exceed the respective 1% screening criterion are depicted in **Figure 2** (annual mean NO_x),

5.1.3. **Figure** 3 (annual mean NH_3) and **Figure 4** (N-deposition), based on results presented in **Appendix D**.

5.1.4. Data pertaining to each transect receptor output point for each pollutant and each scenario (i.e. complete data set of model results) can be provided on request. Full data tables have been excluded from this report to limit file size.

5.1. ANNUAL MEAN NO_X

5.1.4. A summary of the predicted changes in annual mean concentrations at all transect receptor points within the South Pennine Moors SAC/SPA is presented in **Table 6.** The results pertaining to the receptors predicted to experience an increase in annual mean NO_x of greater than or equal to 1% of the benchmark (the significance screening criterion), attributed to the Calderdale Local Plan alone and in-combination, are presented in **Appendix D** (**Table D-1**) and depicted in **Figure 2**.

5.1.5. The results reported in **Table 6** demonstrate that an equivalent number of transect receptor points (7no.) are predicted to exceed the relevant benchmark (30 $\mu g/m^3$) in both the 'alone' and 'in-combination' Local Plan scenarios. This is an increase of 1no. receptor in comparison to the Future Baseline scenario.

5.1.6. The predicted exceedances of the annual mean benchmark are all located at receptors adjacent to the M62 motorway. Concentrations in proximity to the M62 motorway are predicted to fall below the 30 $\mu g/m^3$ benchmark at all locations beyond approximately 20 m from the roadside.

5.1.7. With respect to significance screening, the implementation of the Calderdale Local Plan alone is predicted to result in an increase (i.e. worsening) in annual mean concentrations that exceed the 1% criterion at 35no. of the modelled receptors, relative to the '2032 Future Baseline' scenario. No receptors are predicted to experience a decrease (i.e. improvement) as a consequence of the Local Plan being implemented in isolation.

5.1.8. With the Local Plan in-combination, the results indicate that a similar the same number of receptors (36no.) are predicted to experience an increase in concentrations above the 1% criterion. No receptors are predicted to experience a decrease above 1%, relative to the '2032 Future Baseline' scenario.

5.1.9. Of the 574 receptors across the 28 transects included in each model scenario for the South Pennine Moors, approximately 6% (both Local Plan alone and Local Plan in-combination) exceed the criterion where an increase in NO_x is predicted.

5.1.10. The remaining 94% of modelled receptors (both Local Plan alone and Local Plan in-combination) are predicted to experience impacts that are below the 1% criterion, equating to imperceptible changes, resulting in no significant effect, with reference to Natural England guidance[16].

5.1.11. The exceedances of the 1% criterion are predicted across transects nos. 5, 6, 8-10 and 15-17. Exceedances of the 1% criterion at these transects are predicted to occur within 90 m of the roadside, including the A672, M62, A640, and A58 as shown in **Figure 2**.

Table 6 – Summary of predicted changes in annual mean NO_x concentrations at transect receptors within South Pennine Moors

Annual Mean NO_x Parameter ($\mu g/m^3$)	Sc. 1 2019 Base	Sc. 2 2032 Fut Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan + Bradford[2,3]
Max. Roadside Contribution (*Model*)	102.0	29.2	33.1	33.1
Max. Total Concentration (*Model + Background*)	119.8	39.3	43.3	43.3
Number of receptors exceeding benchmark (30 $\mu g/m^3$)	136	6	7	7
Total number of receptors (28 transects)	574	574	574	574
Local Plan Alone (*Sc. 3 – Sc. 2*):				
Maximum worsening ($\mu g/m^3$)	2.2			
Maximum improvement ($\mu g/m^3$)	-			
No. receptors **increasing** $\geq$1% criterion	35			
No. receptors **decreasing** $\leq$-1% criterion	-			
Local Plan In-Combination (*Sc. 4 – Sc. 2*):				
Maximum worsening ($\mu g/m^3$)	2.3			
Maximum improvement ($\mu g/m^3$)	-			
Number of receptors **increasing** $\geq$1% criterion	36			
Number of receptors **decreasing** $\leq$-1% criterion	-			

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan
Note: All 2032 scenarios based on 2030 vehicle emissions factors

5.2. ANNUAL MEAN NH_3

5.2.1. A summary of the predicted changes in annual mean concentrations at all transect receptor points within the South Pennine Moors SAC/SPA is presented in **Table 7**. The results pertaining to the receptors predicted to experience an increase in annual mean NH_3 of greater than or equal to 1% of the benchmark (the significance screening criterion), attributed to the Calderdale Local Plan alone and in-combination, are presented in **Appendix D** (**Table D-2**) and depicted in **Figure 3**.

5.2.2. The predicted annual mean NH_3 concentrations at all receptors are predicted to exceed the relevant assessment benchmark (1 $\mu g/m^3$) in each scenario, given that the baseline levels reported by APIS are above the benchmark (see **Table 5**).

5.2.3. With respect to significance screening, as reported in **Table 7**, the implementation of the Calderdale Local Plan alone is predicted to result in an increase (i.e. worsening) in annual mean concentrations that exceed the 1% criterion at 73no. of the modelled receptors, relative to the '2032 Future Baseline' scenario. No receptors are predicted to experience a decrease (i.e. improvement) as a consequence of the Local Plan being implemented in isolation.

5.2.4. With the Local Plan in-combination, the results indicate that a similar number of receptors (75no.) are predicted to experience an increase in concentrations above the 1% criterion, with no receptors predicted to experience a decrease above 1%.

5.2.5. Of the 574 receptors across the 28 transects included in each model scenario for the South Pennine Moors, approximately 13% (Local Plan alone and in-combination) exceed the criterion where an increase in NH_3 is predicted.

5.2.6. The remaining 87% (alone and in-combination) of modelled receptors are predicted to experience impacts that are below the 1% criterion, equating to imperceptible changes, resulting in no significant effect, with reference to Natural England guidance[16].

5.2.7. The exceedances of the 1% criterion are predicted across transects nos.1, 4-11, 13-17, 20 and 21. Exceedances of the 1% criterion at these transects, predominantly occur within 80 m of the roadside, with the exception of the A672, where exceedances of the criterion are predicted up to 130 m from the road. The locations of these exceedances are depicted in **Figure 3**.

Table 7 – Summary of predicted changes in annual mean NH_3 concentrations at transect receptors within South Pennine Moors

Annual Mean NH_3 Parameter (µg/m^3)	Sc. 1 2019 Base	Sc. 2 2032 Fut Base[1]	Sc. 3 2032 With Local Plan Excluding Cumulative[2]	Sc. 4 2032 With Local Plan Including Cumulative[2,3]
Max. Roadside Contribution (*Model*)	2.0	2.5	3.0	3.0
Max. Total Concentration (*Model* + *Background*)	3.6	2.5	4.5	4.5
Number of receptors exceeding benchmark (1 µg/m^3)	574*	574*	574*	574*
Total number of receptors (28 transects)	574	574	574	574
Local Plan Alone (*Sc. 3 – Sc. 2*):				
Maximum worsening (µg/m^3)	0.2			
Maximum improvement (µg/m^3)	-			
No. receptors **increasing** ≥1% criterion	73			
No. receptors **decreasing** ≤-1% criterion	-			
Local Plan In-Combination (*Sc. 4 – Sc. 2*):				
Maximum worsening (µg/m^3)	0.2			
Maximum improvement (µg/m^3)	-			
Number of receptors **increasing** ≥1% criterion	75			
Number of receptors **decreasing** ≤-1% criterion	-			

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan
Note: All 2032 scenarios based on 2030 vehicle emissions factors

* Maximum annual average background NH_3 concentration (1.5 µg/m^3) is in exceedance of the benchmark (see **Table 5**)

5.3. N-DEPOSITION

5.3.1. A summary of the predicted changes in annual N-deposition rates at all transect receptor points within the South Pennine Moors SAC/SPA is presented in **Table 8**. The results pertaining to the receptors predicted to experience an increase in deposition of greater than or equal to 1% of the benchmark (5 kgN/ha/yr), attributed to the Calderdale Local Plan alone and in-combination, are presented in **Appendix D** (**Table D-3**) and depicted in **Figure 4**.

5.3.2. The predicted total N-deposition rates at all receptors, in each scenario, are predicted to exceed the respective critical load ranges due to existing levels of deposition across the South Pennine Moors.

5.3.3. The results of the atmospheric dispersion modelling assessment for N-deposition, reported in **Table 8**, demonstrate that the implementation of the Calderdale Local Plan alone is predicted to result in an increase in annual N-deposition that exceeds the 1% significance screening criterion at 112no. of the modelled ecological receptors, relative to the '2032 Future Baseline' scenario. Conversely, no receptors are predicted to experience a decrease (i.e. improvement).

5.3.4. With the Local Plan in-combination, the results indicate that a similar number of receptors (114no.) are predicted to experience an increase in N-deposition above the 1% criterion, with no receptors predicted to experience a decrease above 1%., relative to the Future Baseline scenario.

5.3.5. The maximum predicted worsening associated with the Local Plan (1.0 kgN/ha/yr) equates to 20% of the assessment benchmark value (5 kgN/ha/yr), which occurs immediately adjacent to the respective modelled road (i.e. 0 m from roadside).

5.3.6. Of the 574 receptors across the 28 transects included in each model scenario for the South Pennine Moors, approximately 20% (Local Plan alone and Local Plan in-combination) exceed the significance screening criterion where an increase in N-deposition is predicted.

5.3.7. The remaining 80% (Local Plan alone and Local Plan in-combination) of modelled receptors are predicted to experience impacts that are below the 1% criterion, equating to imperceptible impacts, resulting in no significant effect with reference to Natural England guidance[16].

5.3.8. The exceedances of the 1% criterion are predicted to occur up to 190 m from the A672 on transect nos. 5 and 6, and within 110 m adjacent to the M62 on transect nos. 1-4 and 7-8. For the remaining transects, the predicted exceedances occur within 100 m from the roadside, as shown in **Figure 4**.

5.3.9. In addition to analysing the results against the 1% criterion, the receptors at which the DMRB LA105[18] criterion (change >0.4 kgN/ha/yr) was exceeded are also identified within **Table 8**. A total of seven receptors in both the 'alone' and 'in-combination' assessment scenarios are predicted to exceed this criterion. However, five of these are predicted at 0 m from the A672 (transects 5-6) and A58 (transects 15-17), with the remaining two predicted to occur at 10 m from the A672 roadside (transects 5-6).

Table 8 – Summary of predicted changes in N-deposition rates at transect receptors within South Pennine Moors

N-Deposition Parameter (kgN/ha/yr)	Sc. 1 2019 Base	Sc. 2 2032 Fut Base[1]	Sc. 3 2032 With Local Plan Excluding Cumulative[2]	Sc. 4 2032 With Local Plan Including Cumulative[2,3]
Max. Roadside Contribution (*Model*)	17.0	15.0	17.7	17.7
Max. Total Concentration (*Model* + *Background*)	43.6	41.6	44.3	44.3
Number of receptors exceeding benchmark (5 kgN/ha/yr)	574	574	574	574
Total number of receptors (28 transects)	574	574	574	574
Local Plan Alone (*Sc. 3 – Sc. 2*):				
Maximum worsening (kgN/ha/yr)	1.0			
Maximum improvement (kgN/ha/yr)	-			
No. receptors **increasing** ≥1% criterion	112			
No. receptors **decreasing** ≤-1% criterion	-			
No. receptors **increasing** ≥ 0.4 kgN/ha/yr	7			
Local Plan In-Combination (*Sc. 4 – Sc. 2*):				
Maximum worsening (kgN/ha/yr)	1.0			
Maximum improvement (kgN/ha/yr)	-			
Number of receptors **increasing** ≥1% criterion	114			
Number of receptors **decreasing** ≤-1% criterion	-			
No. receptors **increasing** ≥ 0.4 kgN/ha/yr	7			

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan
Note: All 2032 scenarios based on 2030 vehicle emissions factors

* Maximum average background N-deposition rate (26.6 kgN/ha/yr) is in exceedance of the benchmark (see **Table 5**)

5.4. SUMMARY OF EFFECTS

5.4.1. With reference to Natural England guidance[16], where the change in concentration/deposition exceeds 1% of the relevant environmental benchmark, the potential for significant effects on the sensitive feature(s) cannot be explicitly ruled out. The outcomes of the assessment appraised within the context of this screening criterion are summarised in **Table 9**.

5.4.2. Exceedances of the 1% criterion due to increasing vehicle emissions are predicted at up to 6% of total modelled transect receptors and within 90 m of the roadside for annual mean NO_x, and at up to 13% and within 130 m of roadside for annual mean NH_3 (both in terms of assessing the Local Plan alone and in-combination).

5.4.3. For N-deposition, up to 20% of the transect receptors are predicted to exceed the 1% criterion up to 190 m from the respective modelled (both in terms of assessing the Local Plan alone and in-combination).

Table 9 – Summary of potential effects based on 1% screening criterion

Calderdale Local Plan		Number of receptors exceeding 1% criterion (*Deterioration*)*	Number of receptors below 1% criterion*
Alone	Annual NO_x	35 (6%)	539 (94%)
	Annual NH_3	73 (13%)	501 (87%)
	N-Deposition	112 (20%)	462 (80%)
In-Comb	Annual NO_x	36 (6%)	538 (94%)
	Annual NH_3	75 (13%)	499 (87%)
	N-Deposition	114 (20%)	460 (80%)

* Number of receptors given as a percentage of total (574no. receptors)

5.5. GRIDDED RECEPTOR RESULTS

5.5.1. In addition to the discrete receptor transects reported above, a 200 m x 200 m Cartesian receptor grid was modelled within a minimum distance of 500 m from the ARN to provide an indication of the total area of the South Pennine Moors SPA/SAC that is predicted to exceed the 1% significance screening criterion for each pollutant, respectively, when assessing the implementation of the Calderdale Local Plan 'alone' and 'in-combination'. Given the resolution of the grid, a conservative approach was adopted whereby any single grid receptor, where the 1% criterion is predicted to be exceeded, was assumed to represent the entire 200 m x 200 m area surrounding it.

5.5.2. The relevant outputs from the grid modelling, in terms of total area of both the modelled grid (6,130 ha) and the relevant area of the SAC/SPA (65,024.36 ha SAC and 20944.42 ha SPA) that is predicted to exceed the 1% significance criterion, are summarised in **Table 10**. The results pertaining to the grid receptor locations are presented in **Appendix D** (**Tables D-4 to D-6**) and depicted in **Figures 6 to 9** for both the Calderdale Local Plan 'alone' and 'in-combination'.

5.5.3. Exceedances of the 1% criterion due to increasing vehicle emissions in the Calderdale Local Plan 'alone' and 'in-combination' assessment scenarios are predicted at approximately 0.6% of the respective SPA/SAC area for annual mean NO_x, at up to 1.0% for annual mean NH_3, and up to 1.6%

of the total area for N-deposition. For each pollutant, the exceedances predominantly occur adjacent to the A672, the A58, and the A640, all of which run through the designated site.

Table 10 – Summary of gridded receptor outputs relative to 1% screening criterion and total area of SAC/SPA

Calderdale Local Plan		Area of model grid exceeding 1% criterion (*Deterioration*)*	Area of SAC exceeding 1% criterion (*Deterioration*)**	Area of SPA exceeding 1% criterion (*Deterioration*)**
Alone	Annual NO_x	1.9%	0.2%	0.6%
	Annual NH_3	3.0%	0.3%	0.9%
	N-Deposition	4.7%	0.4%	1.4%
In-Comb	Annual NO_x	1.9%	0.2%	0.6%
	Annual NH_3	3.0%	0.3%	0.9%
	N-Deposition	4.7%	0.4%	1.4%
Total combined area of modelled grid = 6,130 hectares. Area of South Pennine Moors SAC = 65,024.32. Area of South Pennine Moors (Part 2) SPA = 20,944.46 hectares. * Given as a % of modelled grid area. ** Given as a % of SAC/SPA area.				

ISOPLETH MAPPING – HABITATS OF PRINCIPAL IMPORTANCE

NO_x

5.5.4. As can be seen from Figure 10c there are areas of the SAC/SPA which will exceed the NO_x critical limit of 30 µg/m^3, further, small areas of this exceedance lie within sensitive blanket bog habitat. However, as can be seen from Figure 10e, the changes arising from the Local Plan in-combination with other plans or projects do not fall within these exceedance areas.

5.5.5. Further, as can be seen from the isopleth mapping (Figure 10e), the NOx changes only impact upon very small areas of blanket bog directly adjacent to Rochdale Road (<5 ha), while the majority of the change falls within grass moorland which represents site fabric and not designation feature habitats.

NH_3

5.5.6. Figure 11c shows that there are areas of the SAC/SPA which exceed the NH_3 critical limit of 1 µg/m^3. Small areas of the SAC/SPA will experience up to 3 µg/m^3, within some these exceedances falling within sensitive blanket bog habitat. However, as can be seen from Figure 11e the changes in NH_3 fall within a single area experiencing this exceedance, directly adjacent to the A672.

5.5.7. As Figure 11e demonstrates, none of the NH_3 changes arising from the Local Plan in-combination with other plans or projects fall within sensitive habitats. The habitat experiencing change as a result of the Local Plan in-combination is grass moorland which represents site fabric and not designation feature habitats.

N-deposition

5.5.8. Figure 12c demonstrates that there are areas of the SAC/SPA which are in exceedance of the lower critical load for blanket bog (5 kg/N/yr) and for upland heathland (10 kg/N/yr), with blanket bog and upland heathland being the only designation habitats which are present within the modelled area.

5.5.9. As can be seen from Figure 12e, there are two areas of blanket bog which will experience a change in N-deposition which lie within blanket bog habitat, and none which lie within upland heathland habitat. The areas which lie within blanket bog habitat total <5 ha. While the majority of N-Dep change falls on grass moorland which represents site fabric and is not a designation feature habitat.

5.5.10. Examination of the APIS Critical Load for Bogs tool[36] indicates that the areas of blanket bog which will experience a slight increase in N-deposition as a result of the Local Plan in-combination with other plans or projects has an expected rainfall range of 759-1285 mm of rain per year, and that this would lead to a critical load of 9 kg/N/yr. However, for the avoidance of uncertainty, the lower critical load for this habitat of 5 kg/N/yr was used within the assessment.

[36] www.apis.ac.uk/critical-load-bogs-tool

6. CONCLUSIONS

6.1.1. A detailed air quality assessment has been completed to consider the potential impacts of the proposed Calderdale Local Plan on potentially sensitive ecological designated sites within Calderdale, which has primarily focussed on the South Pennine Moors SAC and SPA. The South Pennine Moors contains habitats potentially sensitive to changes in ambient levels of NO_x, NH_3 and deposition of nutrient nitrogen.

6.1.2. Ambient background levels of annual mean NO_x concentrations across the South Pennine Moors are expected to remain below the annual mean benchmark between 2019 and 2030, with concentrations predicted to decrease over this period. With respect to background levels of NH_3 and N-deposition rates, the highest average values exceed the relevant critical level for the most sensitive habitats (NH_3) and predominantly exceed the relevant critical load ranges given for the sensitive features of the SAC/SPA (N-deposition). For the purposes of this assessment, the highest average deposition rate has been adopted for all receptors, with no reduction assumed over the assessment period to 2032.

6.1.3. Changes in annual mean NO_x and NH_3 concentrations and annual N-deposition rates as a result of traffic changes associated with the Calderdale Local Plan, both alone and in-combination, were predicted using dispersion modelling at 28no. discrete receptor transects within the South Pennine Moors. The methodology adopted and reported within this report has adhered to the scope of work agreed with Natural England[4]. In addition to the agreed scope, this assessment has also considered the potential impact to the SAC/SPA associated with vehicle emissions of NH_3, given the availability of published evidence that contributions from combustion engine vehicles are higher than previously estimated[14].

6.1.4. The predicted magnitude of change relating to annual mean NO_x concentrations and annual N-deposition rates at each transect receptor, as a result of the Calderdale Local Plan implementation, has been derived through comparing the following scenarios for the assessment year (2032):

- ***2032 With Calderdale Local Plan Only*** versus ***2032 Future Baseline***
  - This provides an assessment of air quality impacts associated with the **Calderdale Local Plan alone**
- ***2032 With Calderdale Local Plan plus Bradford Emerging Plan*** versus ***2032 Future Baseline***
  - This provides an assessment of air quality impacts associated with the **Calderdale Local Plan in-combination** with the Emerging Bradford Local Plan.

6.1.5. The results of the modelling assessment indicated that, in both '*With Local Plan*' scenarios ('alone' and 'in-combination'), predicted exceedances of the annual mean NO_x benchmark (30 $\mu g/m^3$) are all located at receptors adjacent to the M62 motorway. Concentrations in proximity to the M62 motorway are predicted to fall below the benchmark beyond approximately 20 m from the roadside.

6.1.6. The magnitude of changes in annual mean NO_x and NH_3 concentrations and N-deposition rates between the above scenarios were expressed as a percentage of the relevant assessment benchmarks and appraised against the 1% significance screening criterion. For N-deposition rates and NH_3 concentrations, the relevant benchmark was taken as the lowest critical level/load value based on all identified sensitive habitat features within the South Pennine Moors SAC/SPA.

6.1.7. The results of the assessment demonstrate that, with the Calderdale Local Plan implemented, both 'alone' and 'in-combination', the majority of modelled receptors (>80%) are predicted to experience imperceptible impacts for NO_x (94%), NH_3 (87%), and N-deposition (80%).

6.1.8. The modelled receptors predicted to experience an increase in NO_x (6% of all modelled receptors), NH_3 (13%), and N-deposition (20%) above the 1% significance screening criterion are located adjacent to the M62, A672, A640, A58, and B6114.

6.1.9. Based on the air quality assessment results, there are predicted to be impacts to ambient NO_x concentrations, NH_3 concentrations, and N-deposition rates within the South Pennine Moors SAC/SPA that are above the significance screening criterion, with the Local Plan in place. Therefore, the results of the air quality assessment were passed on to a suitably qualified ecologist for an assessment of significance to be made, the outcomes of which are provided in **Section 6.2**.

6.1.10. The air quality assessment has been completed within the context of the assessment limitations (see **Section 3.7**) and, where appropriate, conservative assumptions have been adopted to provide a robust assessment of potential air quality impacts associated with the Calderdale Local Plan.

6.2. ASSESSMENT OF ADVERSE EFFECTS ON SITE INTEGRITY

6.2.1. For the potential increases in pollutants to have an adverse effect on the integrity of the International Sites, there would need to be an effect arising which would be contrary to the Conservation Objectives of the site in such a manner that the effect would reduce the integrity of the Sites.

6.2.2. Site integrity is not clearly defined within the source legislation underpinning the HRA process. The European Commission's guidance 'Managing Natura 2000 Sites'[37] has also set out guidance on the meaning of site integrity. It confirms that the integrity of the site relates to the site's conservation objectives and states that if:

> *'a plan or project will adversely affect the integrity of a site only in a visual sense or only habitat types or species other than those listed in Annex I or Annex II.....the effects do not amount to an adverse effect for purposes of Article 6(3), provided that the coherence of the network is not affected'.*

6.2.3. However, caselaw has determined that 'site integrity' means keeping the site at a favourable conservation status and must be determined with reference to:

> *'the lasting preservation of the constitutive characteristics of the site concerned that are connected to the presence of a priority natural habitat whose preservation was the objective justifying the designation of that site'* [38]

[37] Managing Natura 2000 Sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC.

[38] Case e C-258/11 Peter Sweetman, Ireland, Attorney General, Minister for the Environment, Heritage and the Local Government v An Bord Pleanala Para 39.

LOCAL PLAN – ALONE

6.2.4. Assessing the area of the International Sites (range given for SAC and SPA (see Table 10) subject to an increase in NO_x (0.2-0.6%), NH_3 (0.3-0.9%) and N-dep (0.4-1.4%) arising from the adoption of the Local Plan alone indicates that negative effects on site integrity are unlikely.

6.2.5. Examination of Figure series 10, 11 and 12 shows that neither NO_x nor NH_3 increases above 1% of the critical level fall within sensitive habitats, while the area of sensitive habitat subject to an increase in N-deposition greater than 1% of the lower critical load is <5ha.

6.2.6. Assessing the potential damage to the biodiversity of the International Sites and by association the potential effect on the integrity of these sites, it can be concluded that with less than 0.008% of the sensitive habitats within the SAC and less than 0.024% within the SPA are expected to experience any notable increase in nutrients, the proportion of the International Sites subject to potential degradation is so small that it may be considered *de minimis* and **no adverse effect on site integrity** will arise.

LOCAL PLAN – IN-COMBINATION

6.2.7. In considering the in-combination effects arising from the Local Plan acting in concert with the Bradford Emerging Plan, the areas of the site subject to the potential increases in NO_x, NH_3 and N-deposition remain unchanged.

6.2.8. Therefore, it can be concluded that there will be **no adverse effect on the integrity** of the South Penning Moors SAC or South Pennine Moors (Part 2) SPA, arising from the Local Plan either alone or in-combination.

Figure 1 – Modelled Affected Road Network and Receptor Transects

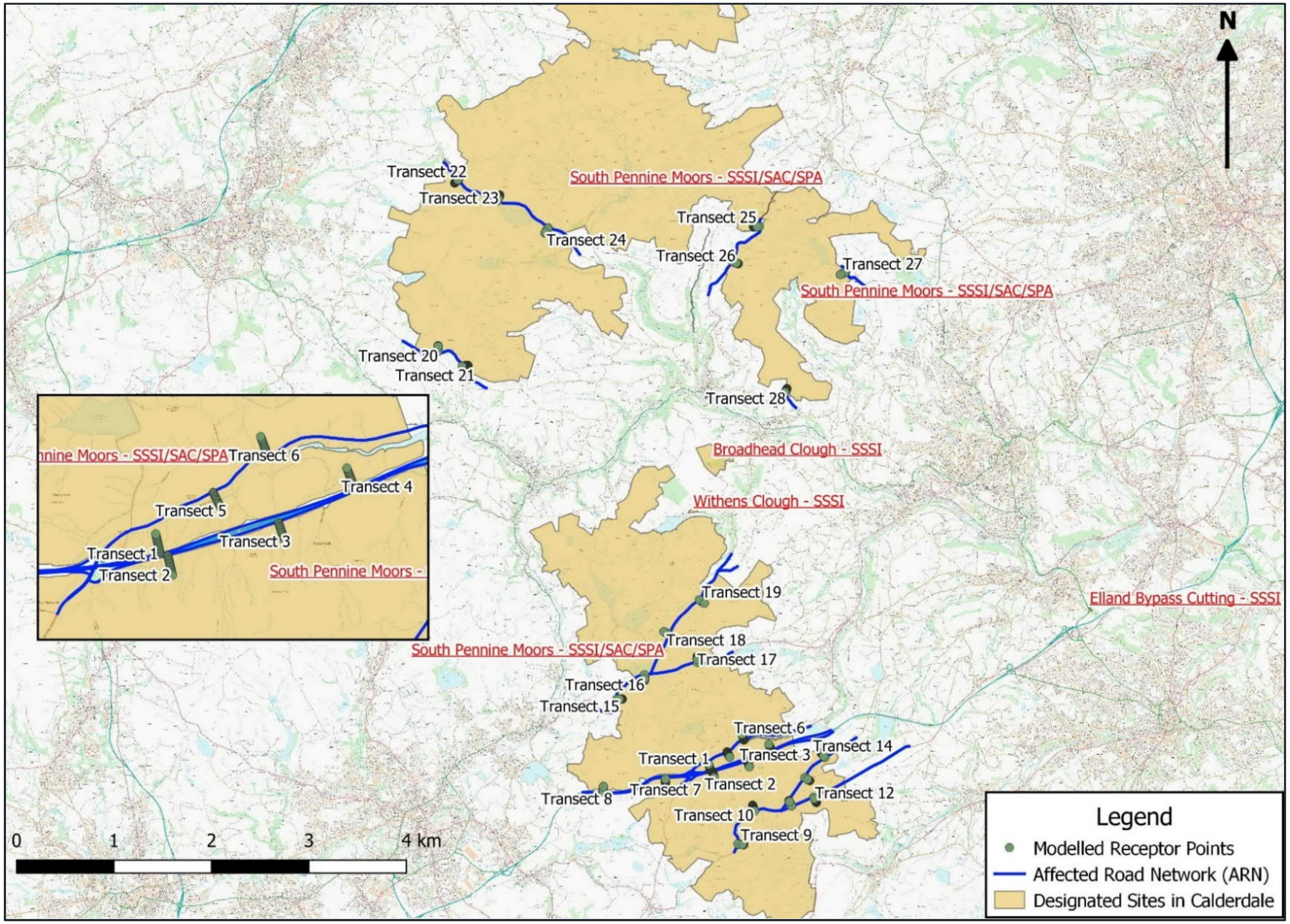


Figure 2 – Receptors Exceeding 1% Significance Screening Criterion for Annual Mean NO_x

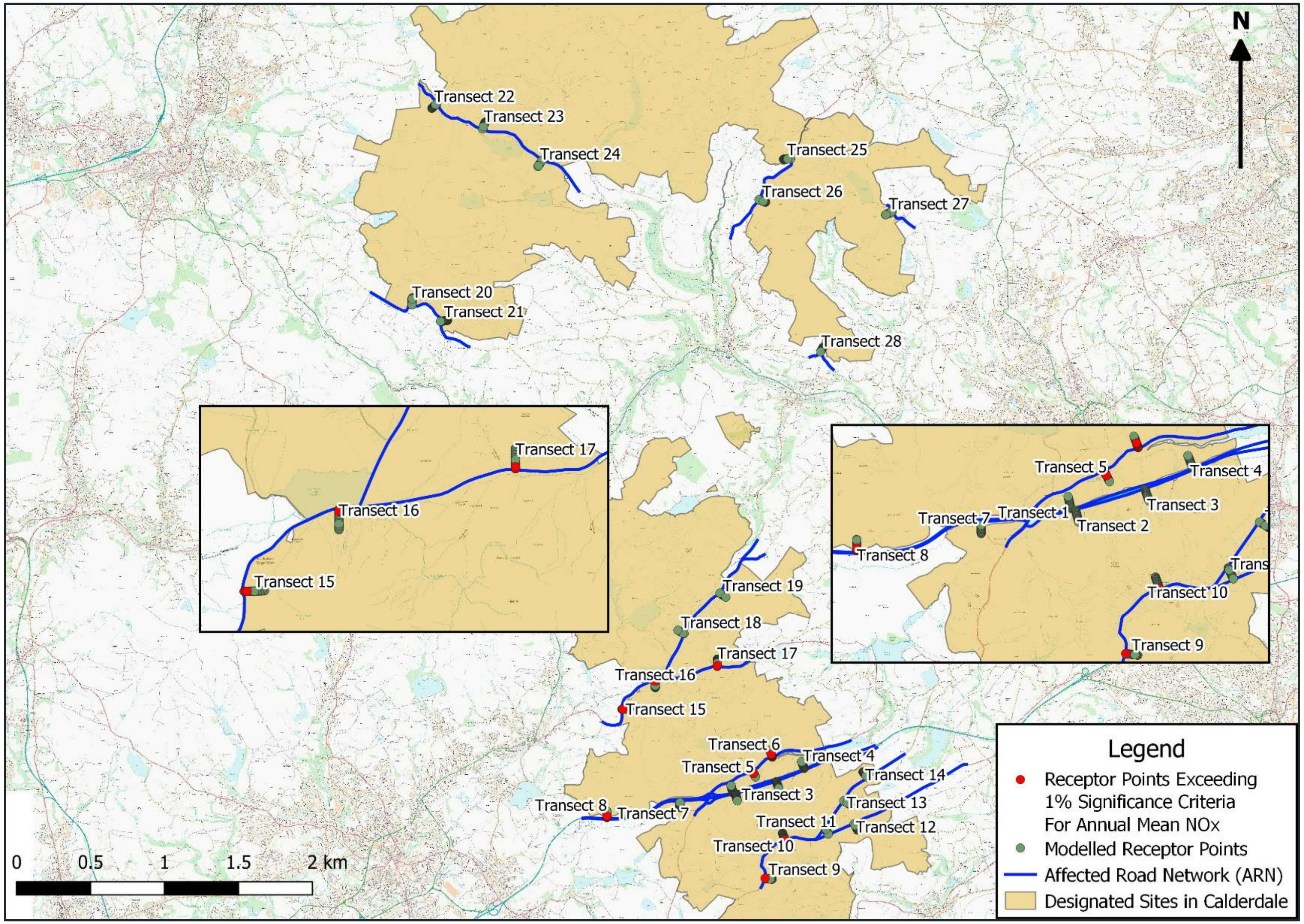
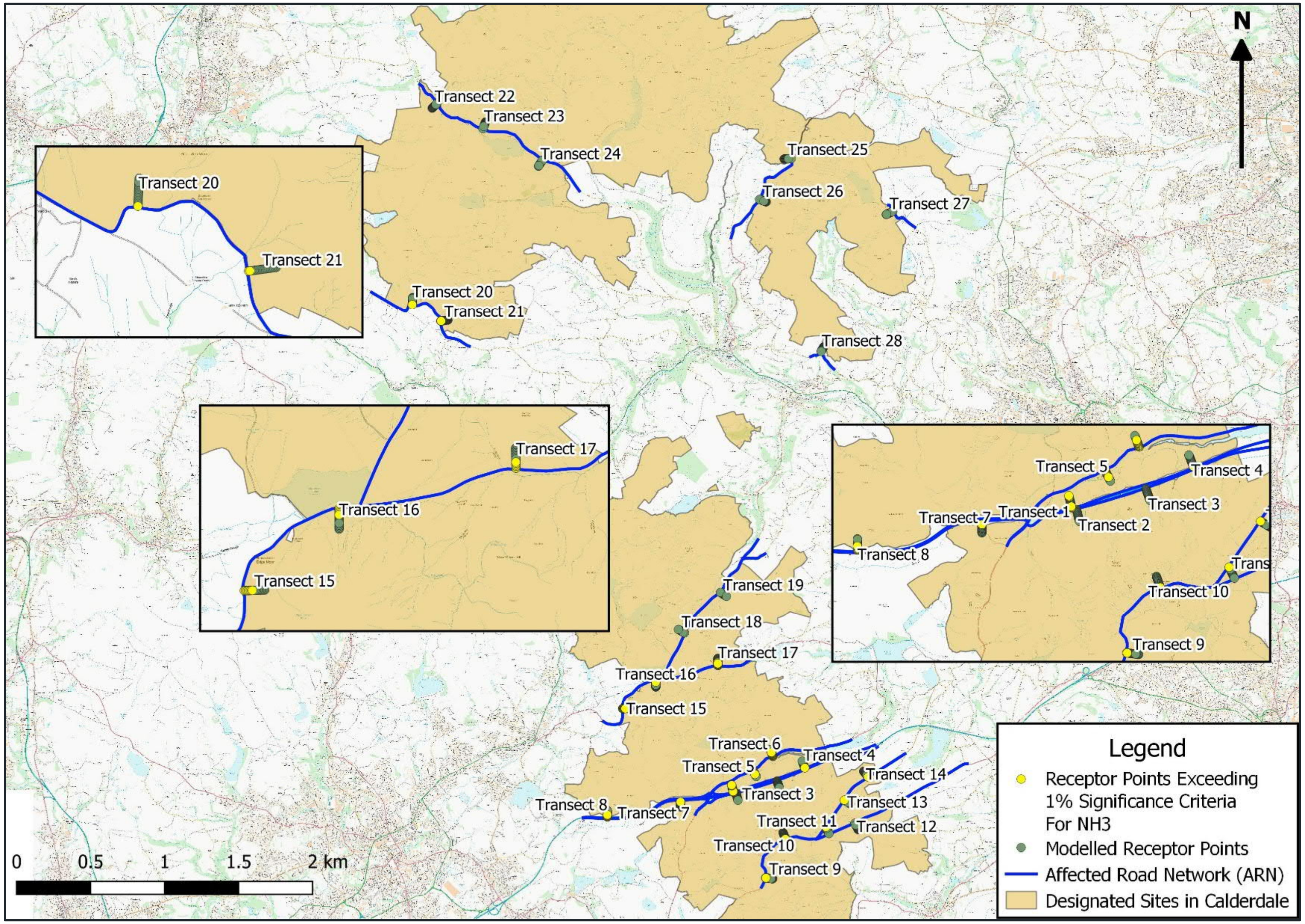


Figure 3 – Receptors Exceeding 1% Significance Screening Criterion for Annual Mean NH_3



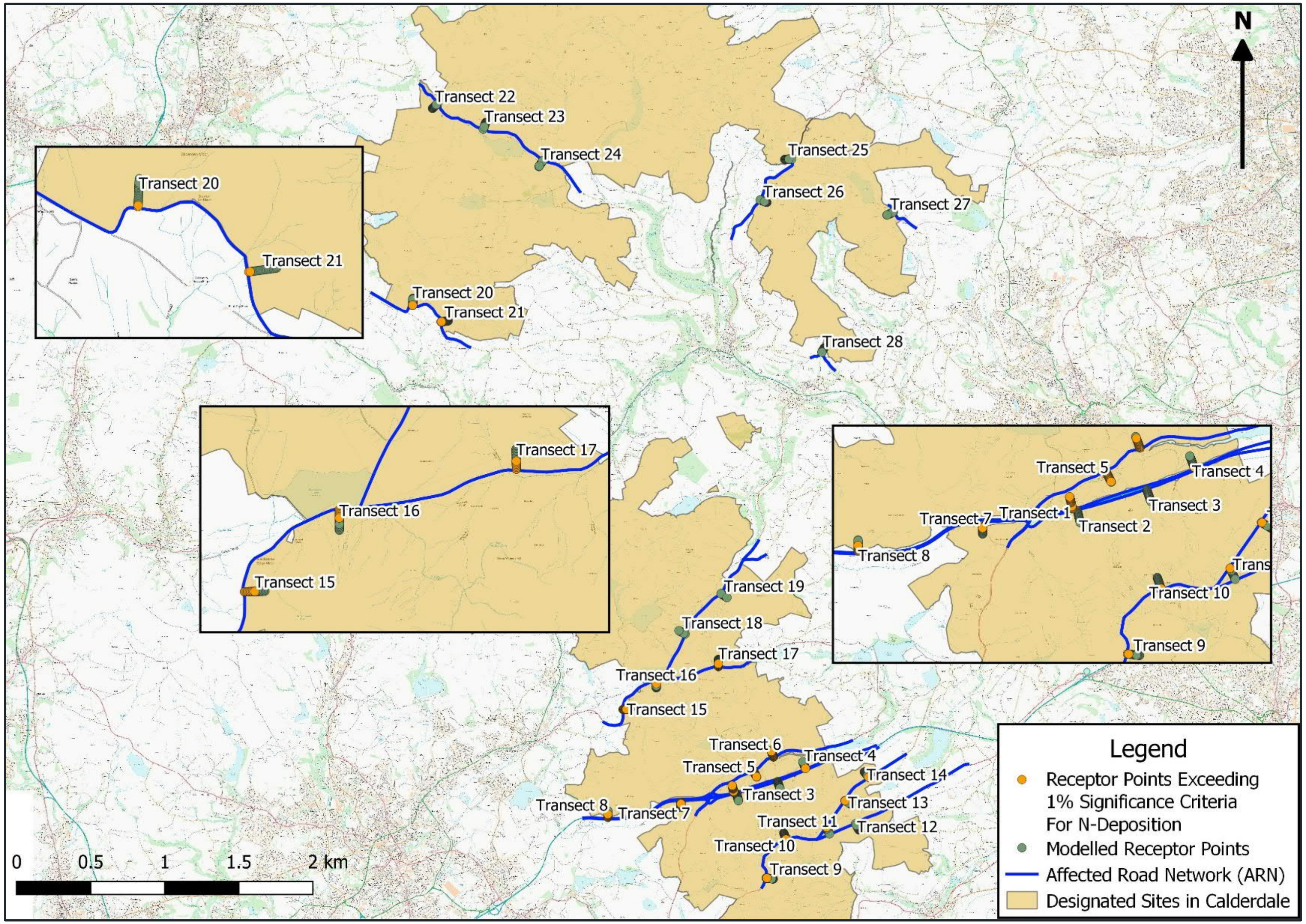


Figure 4 – Receptors Exceeding 1% Significance Screening Criterion for N-Deposition

Figure 5 – Modelled Receptor Grid encompassing Affected Road Network and South Pennine Moors SPA/SAC

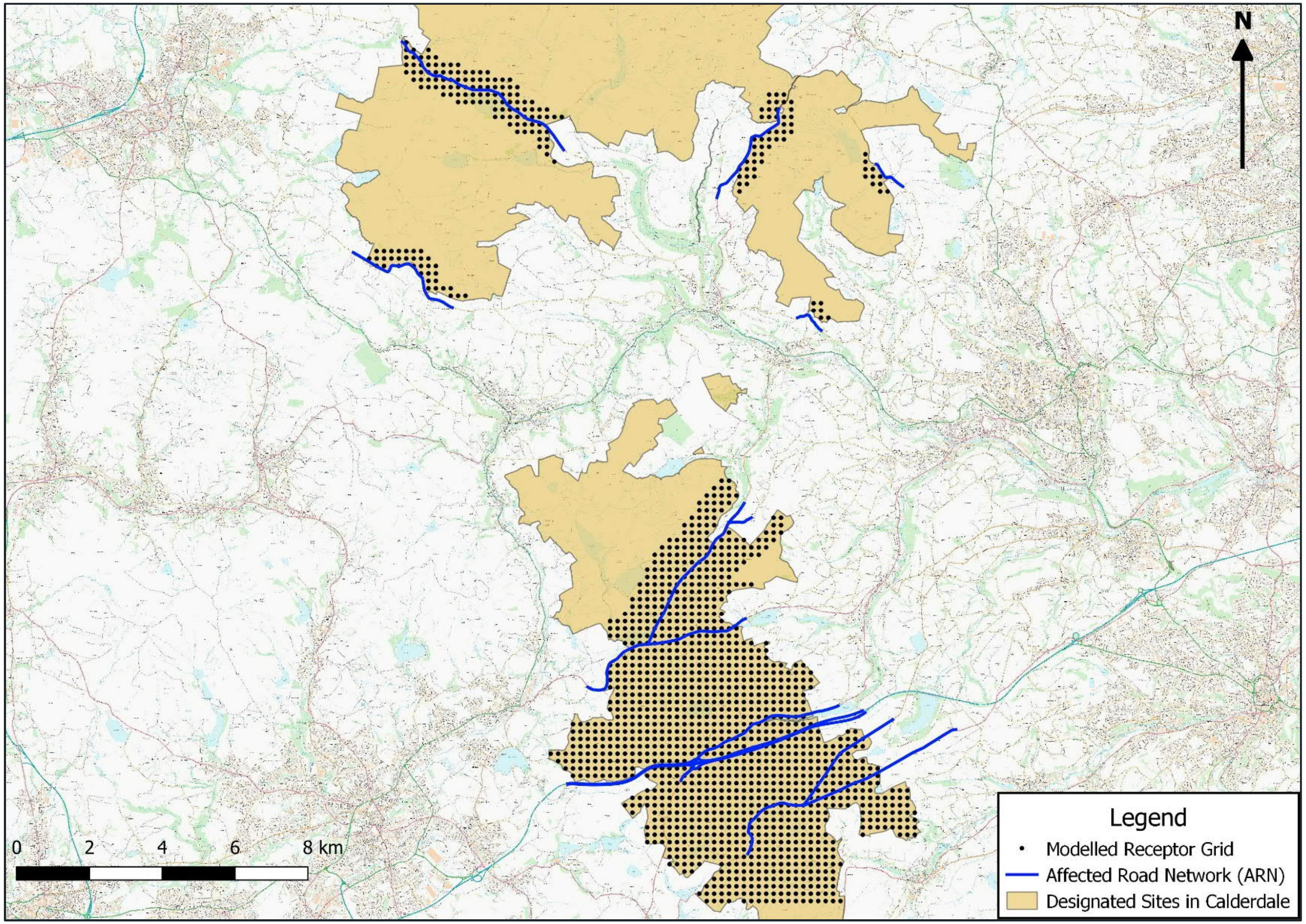


Figure 6 – Grid Receptors Exceeding 1% Significance Screening Criterion for Annual Mean NO_x

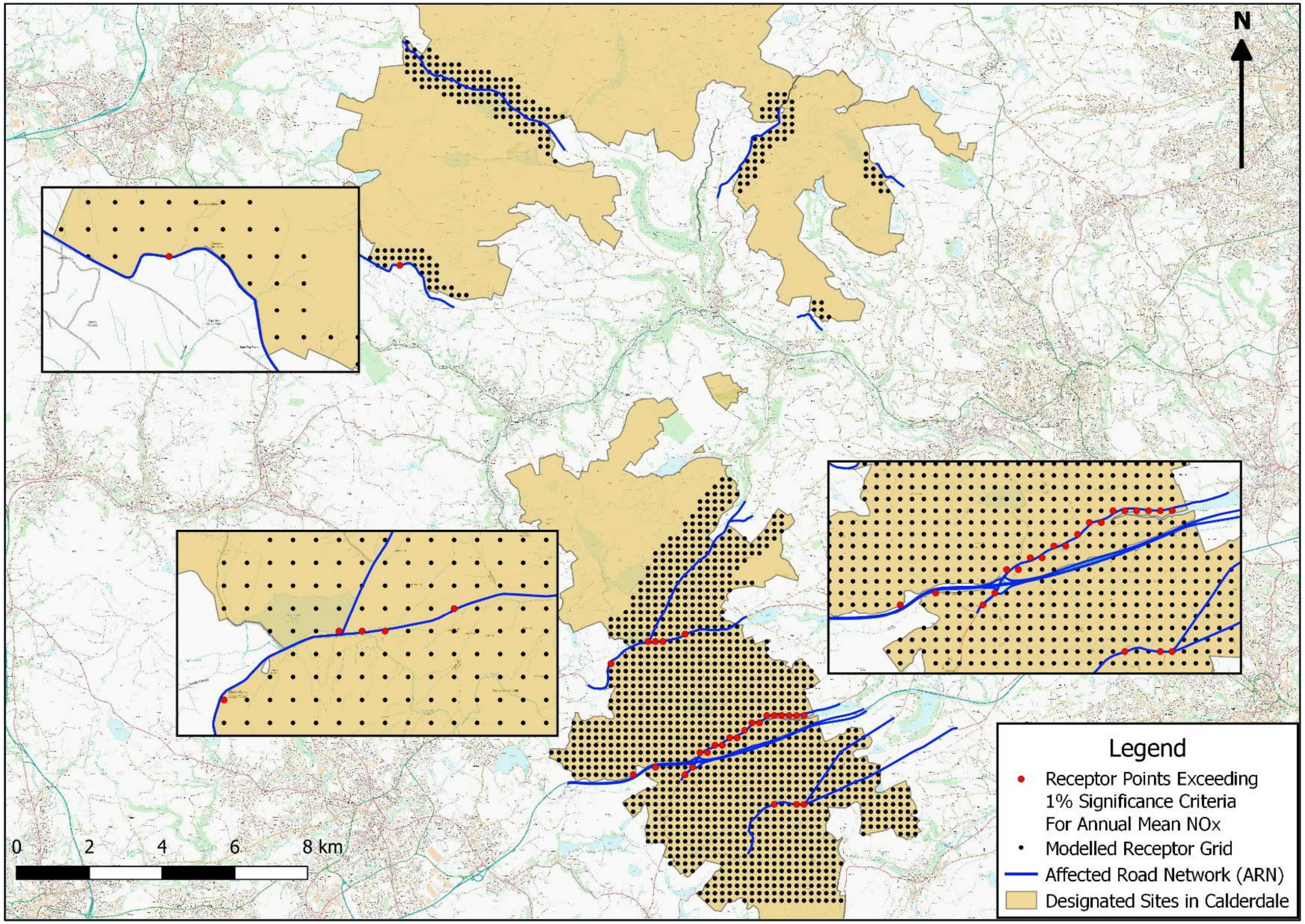


Figure 7 – Grid Receptors Exceeding 1% Significance Screening Criterion for Annual Mean NH_3

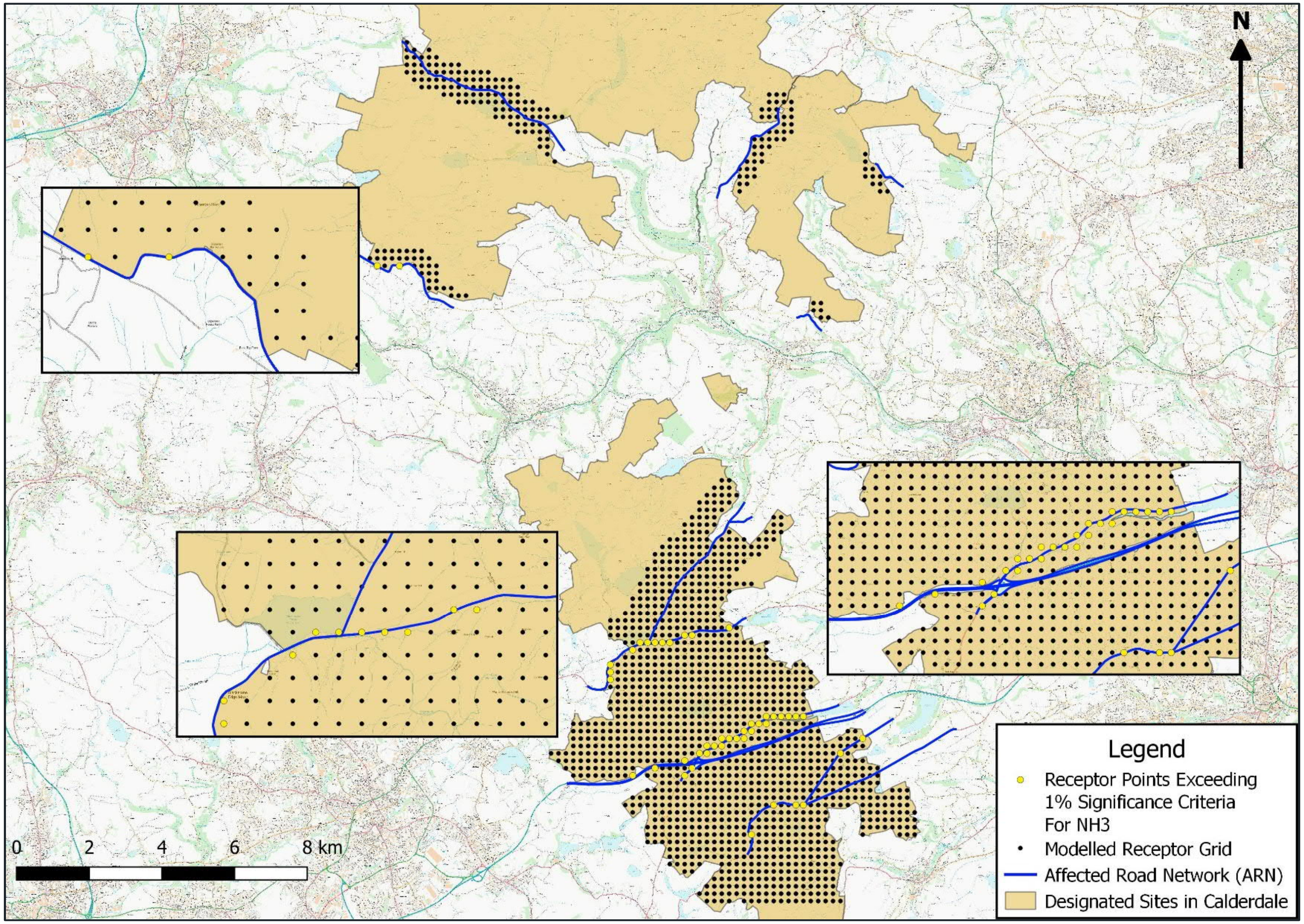


Figure 8 – Grid Receptors Exceeding 1% Significance Screening Criterion for Annual N-Deposition Rate

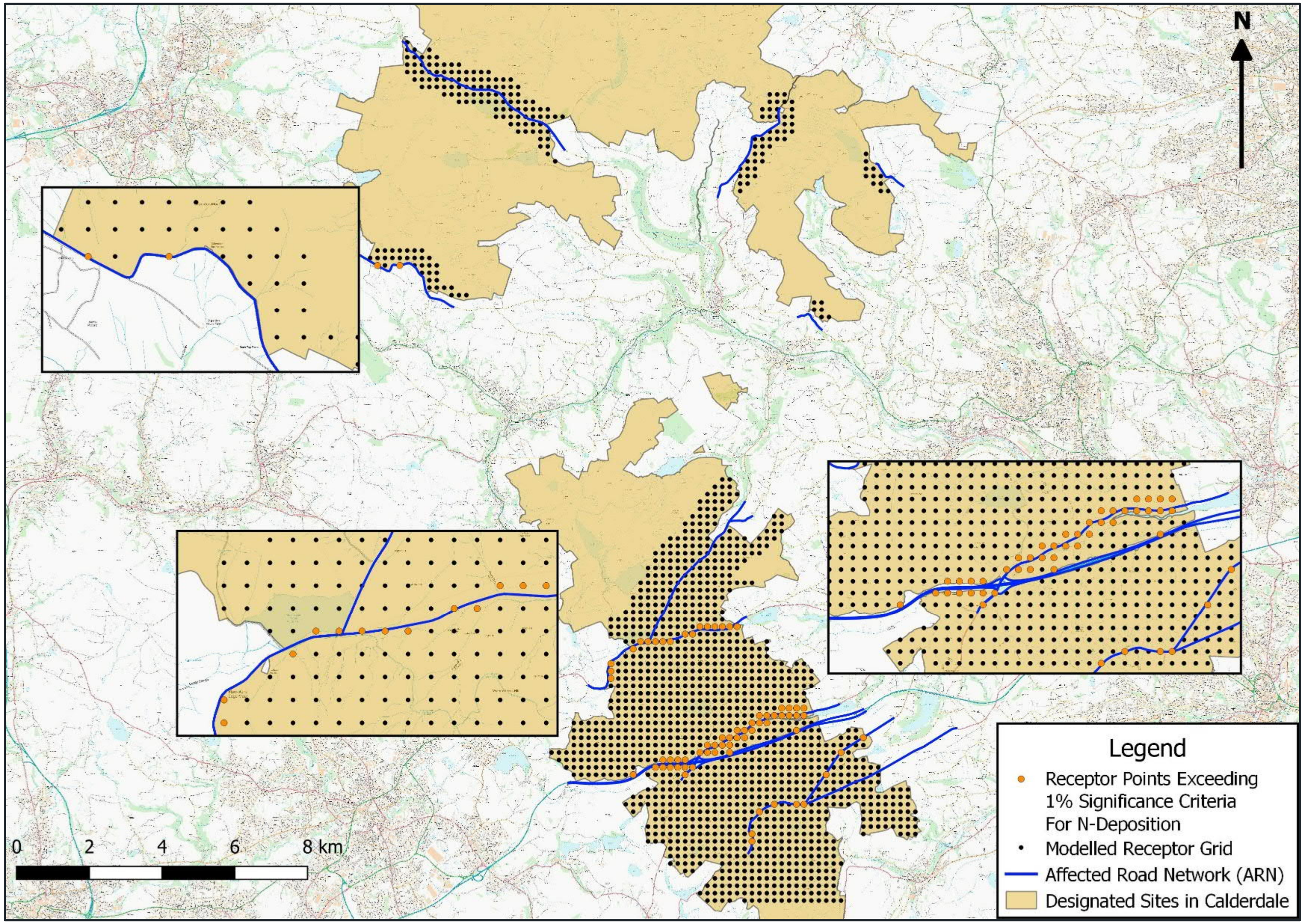
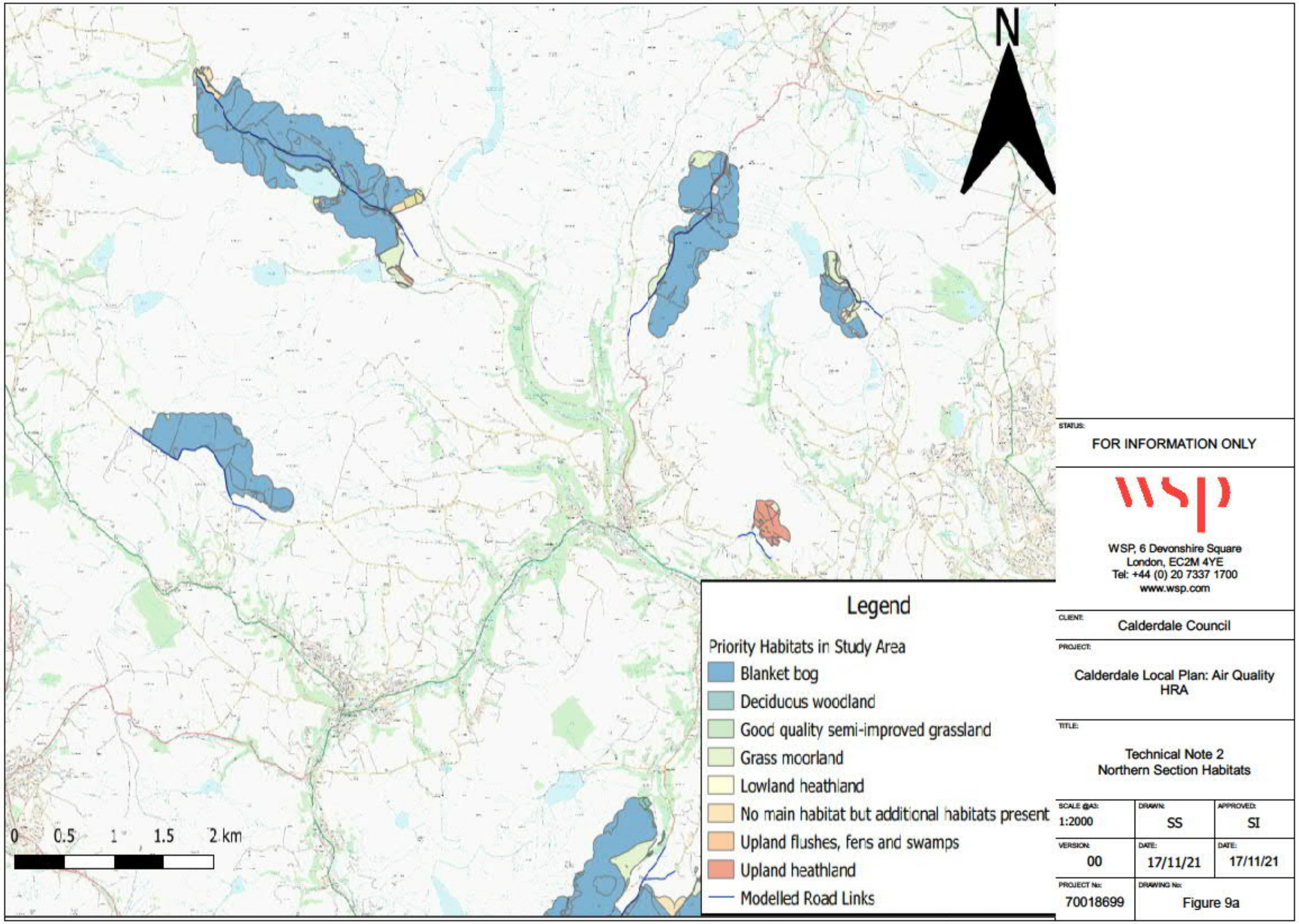


Figure Series 9 – Habitats of Principal Importance



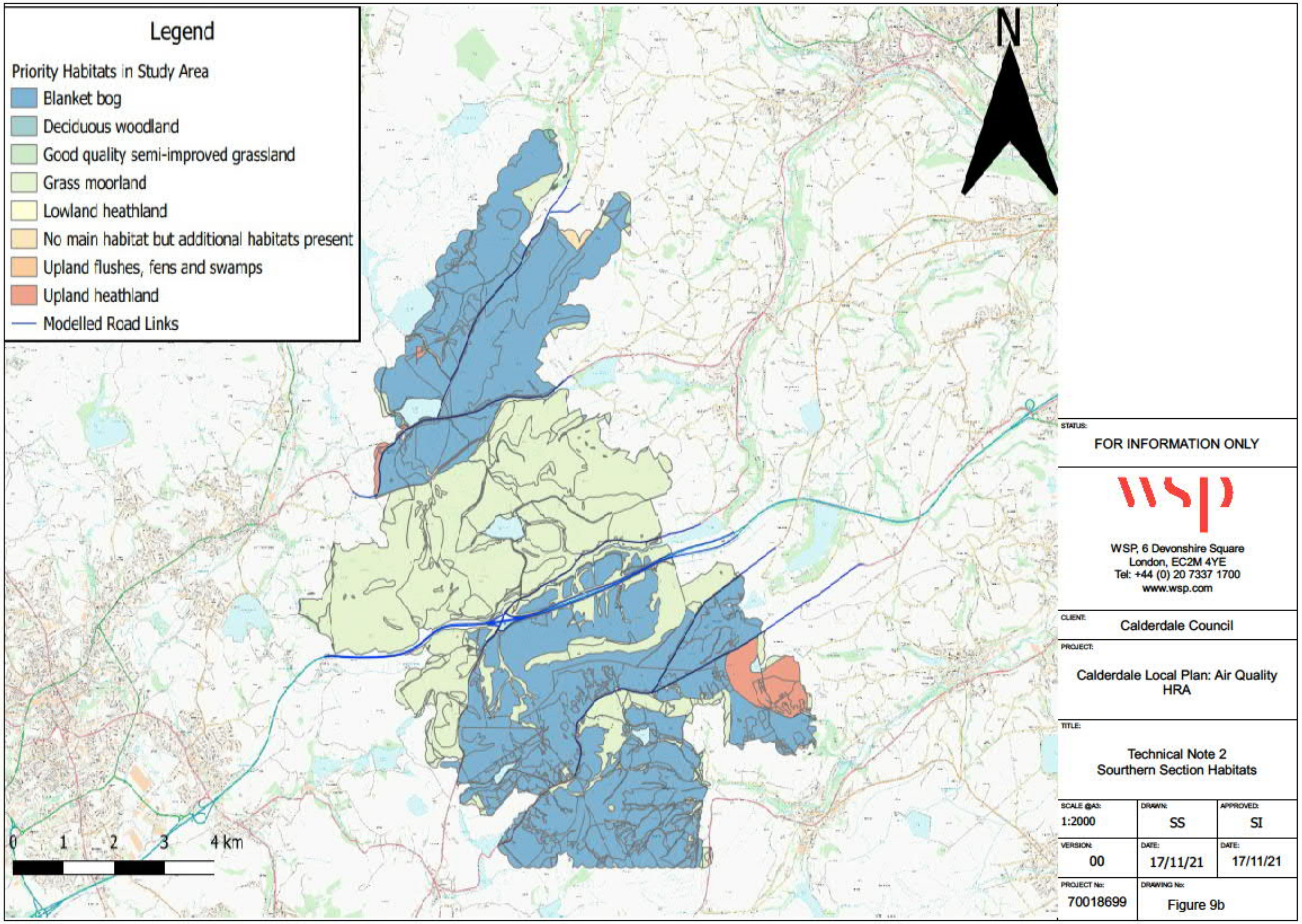
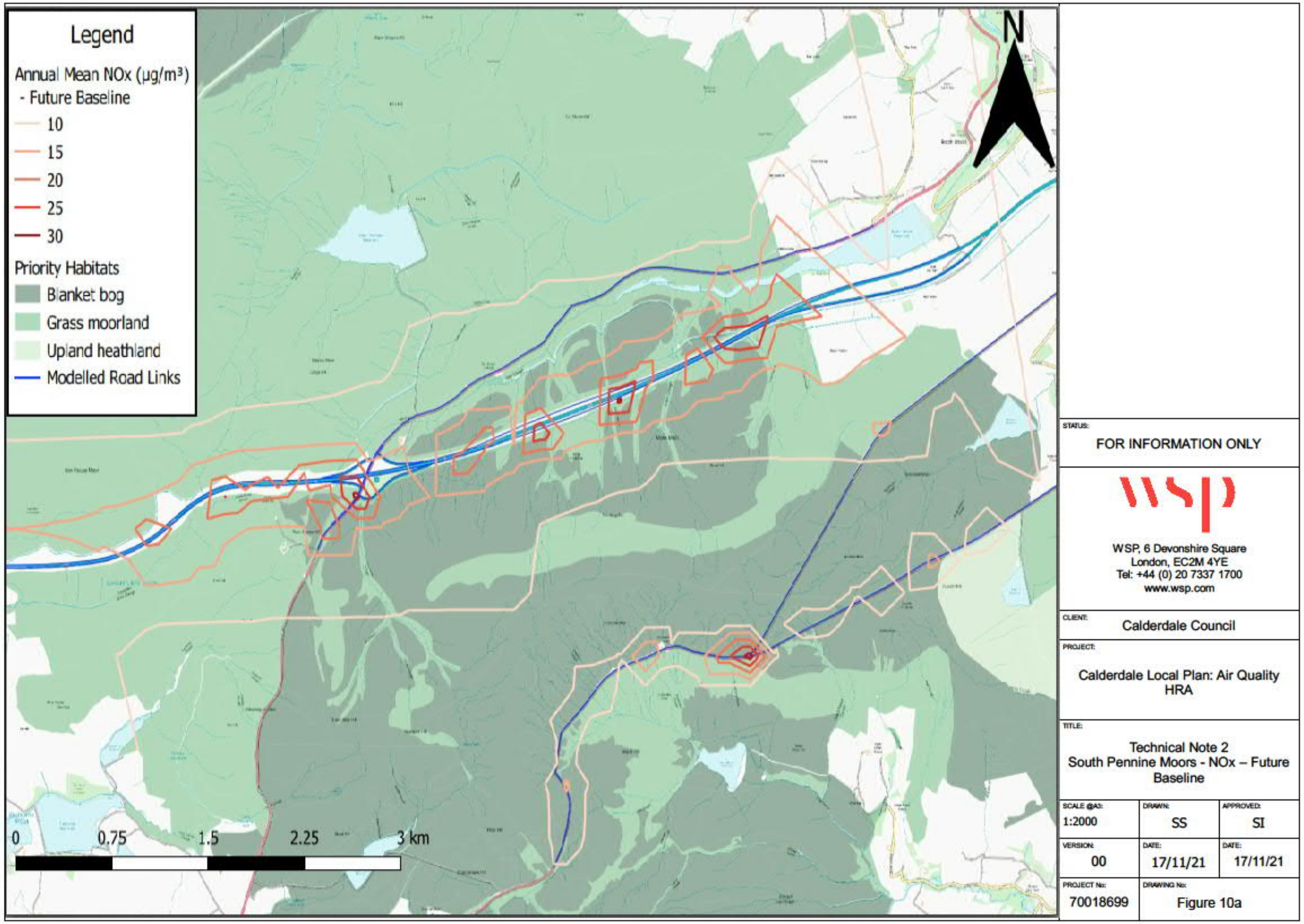
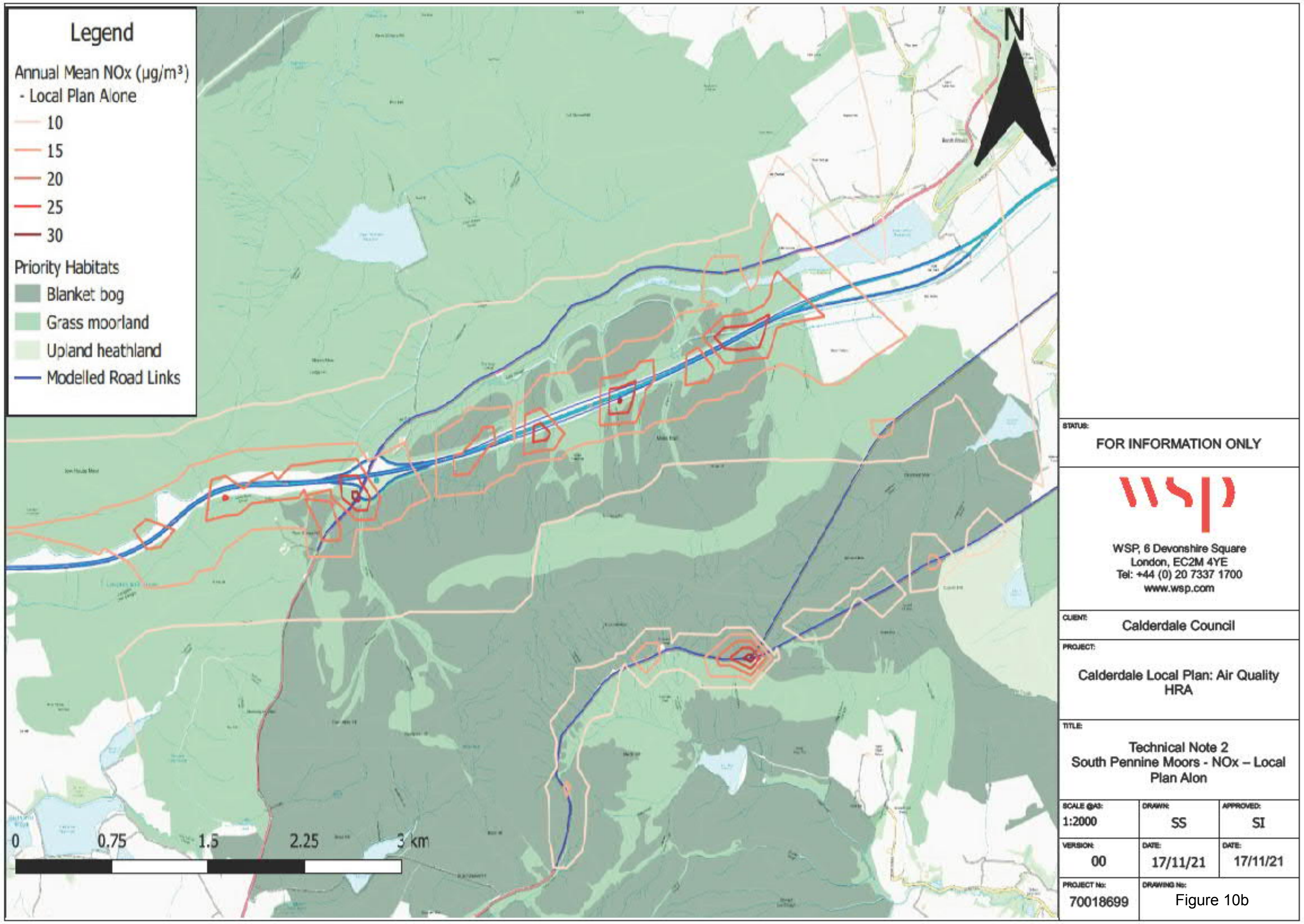
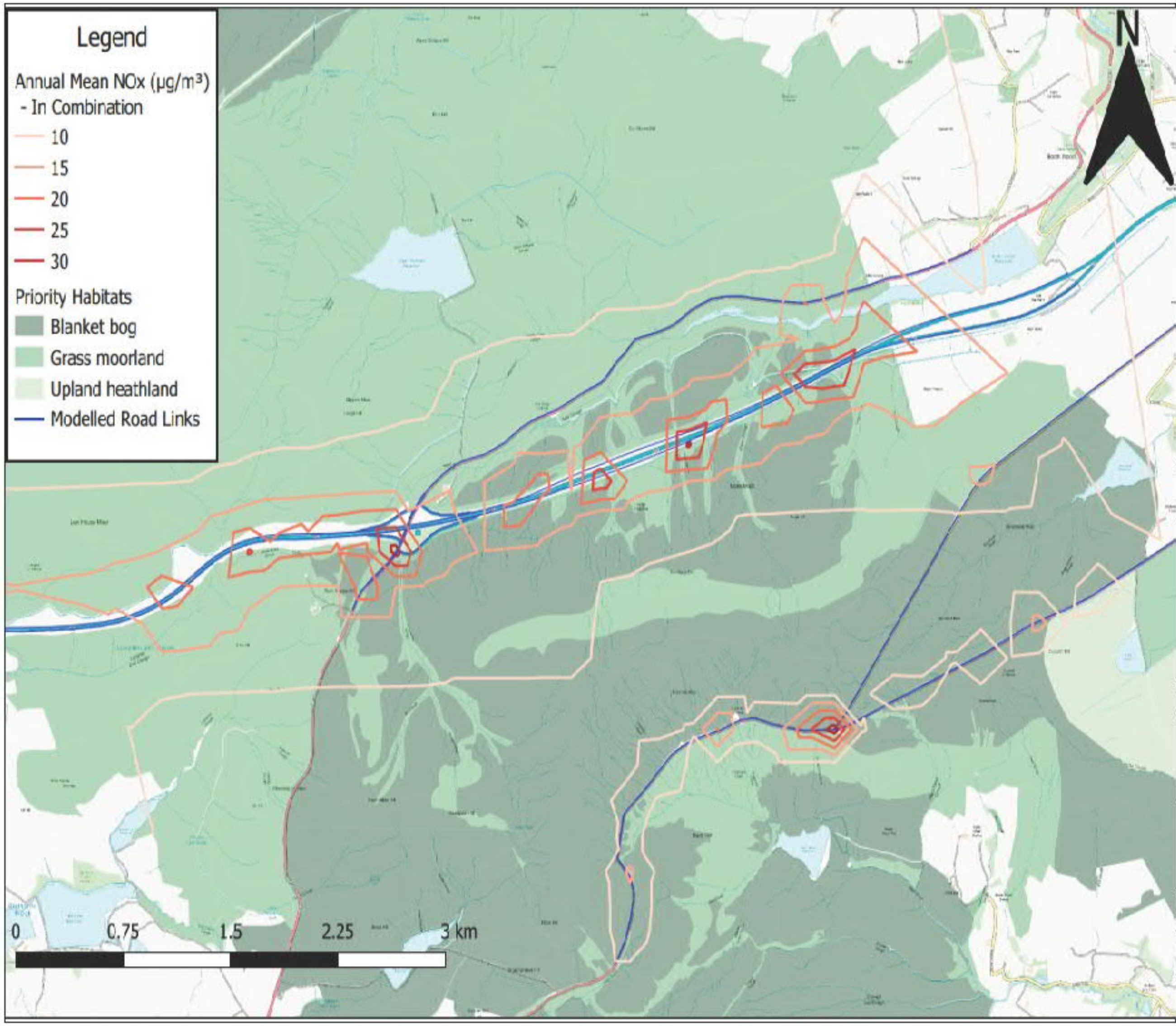

Legend
Priority Habitats in Study Area
Blanket bog
Deciduous woodland
Good quality semi-improved grassland
Grass moorland
Lowland heathland
No main habitat but additional habitats present
Upland flushes, fens and swamps
Upland heathland
Modelled Road Links
N
0 1 2 3 4 km
STATUS:
FOR INFORMATION ONLY
wsp
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
Sourthern Section Habitats
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 9b

Figure Series 10 – NO_x Isopleth Maps




Legend
Annual Mean NOx (µg/m³)
- Local Plan Alone
10
15
20
25
30
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
0
0.75
1.5
2.25
3 km
N
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - NOx – Local Plan Alon
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 10b



STATUS: FOR INFORMATION ONLY

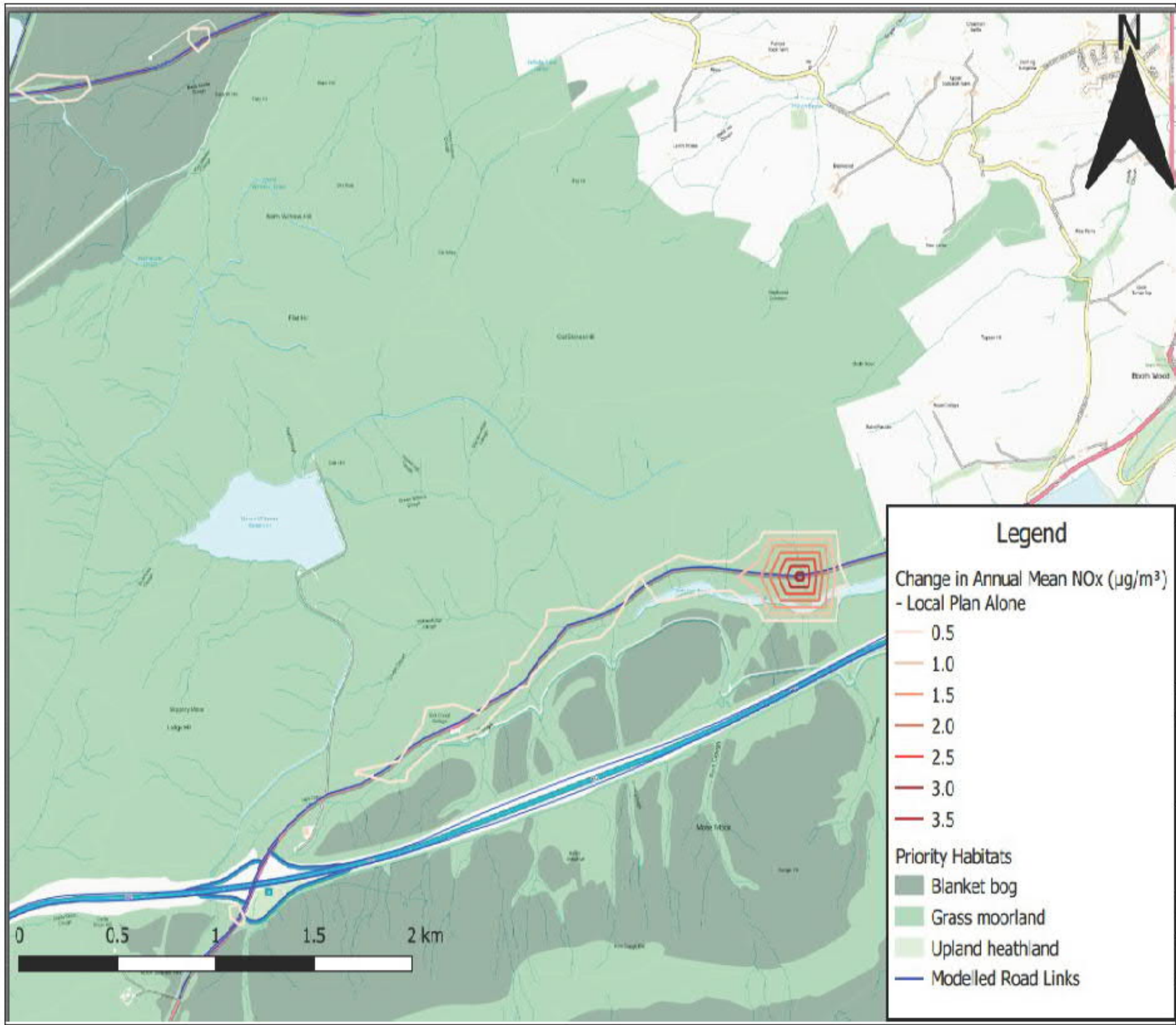
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Calderdale Council

PROJECT: Calderdale Local Plan: Air Quality HRA

TITLE: Technical Note 2
South Pennine Moors - NOx – In-combination

SCALE @A3: 1:2000	DRAWN: SS	APPROVED: SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 10c	



STATUS: FOR INFORMATION ONLY

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Calderdale Council

PROJECT: Calderdale Local Plan: Air Quality HRA

TITLE: Technical Note 2
South Pennine Moors - NOx Change – Local Plan Alone

SCALE @A3:	DRAWN:	APPROVED:
1:2000	SS	SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 10d	

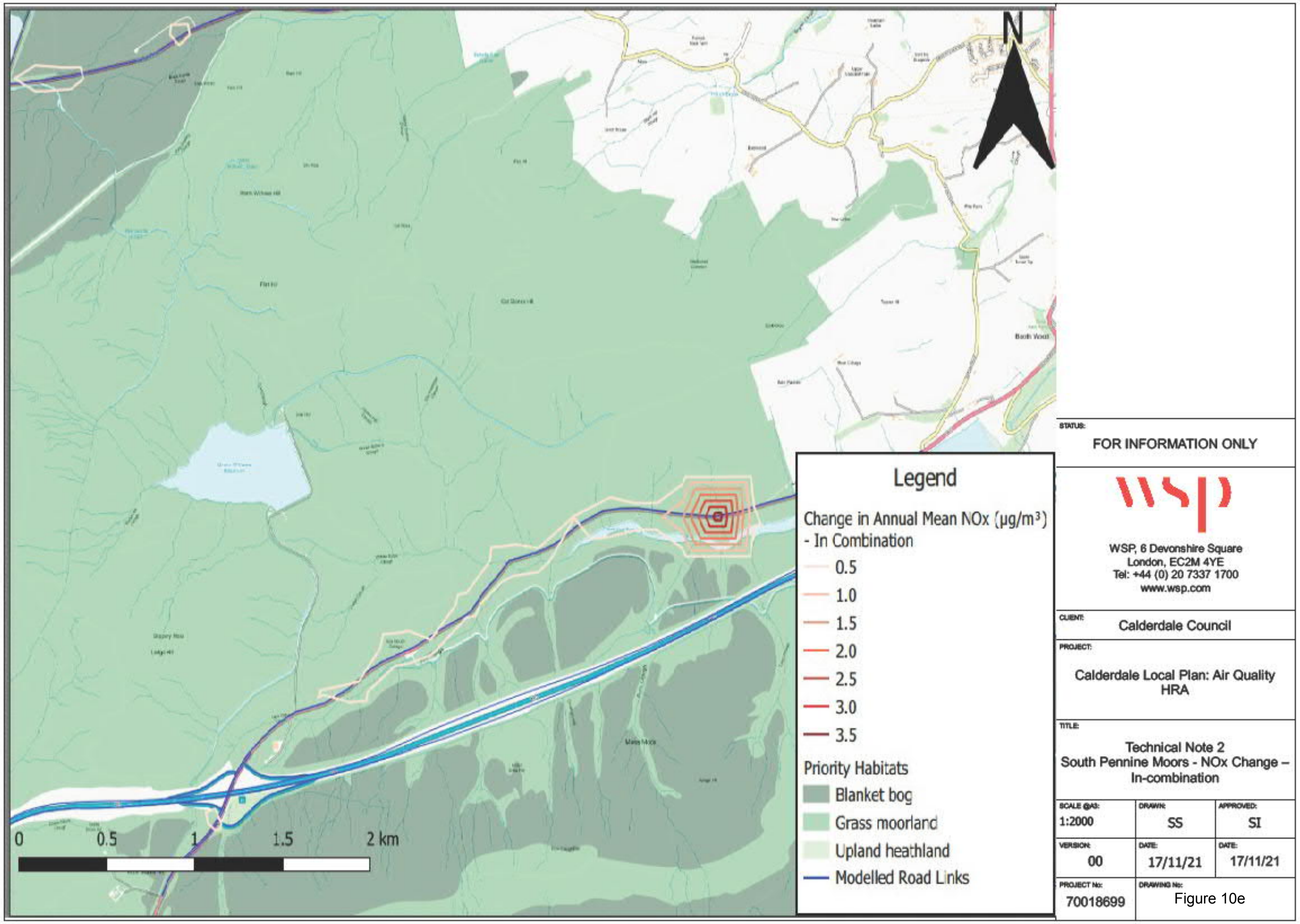
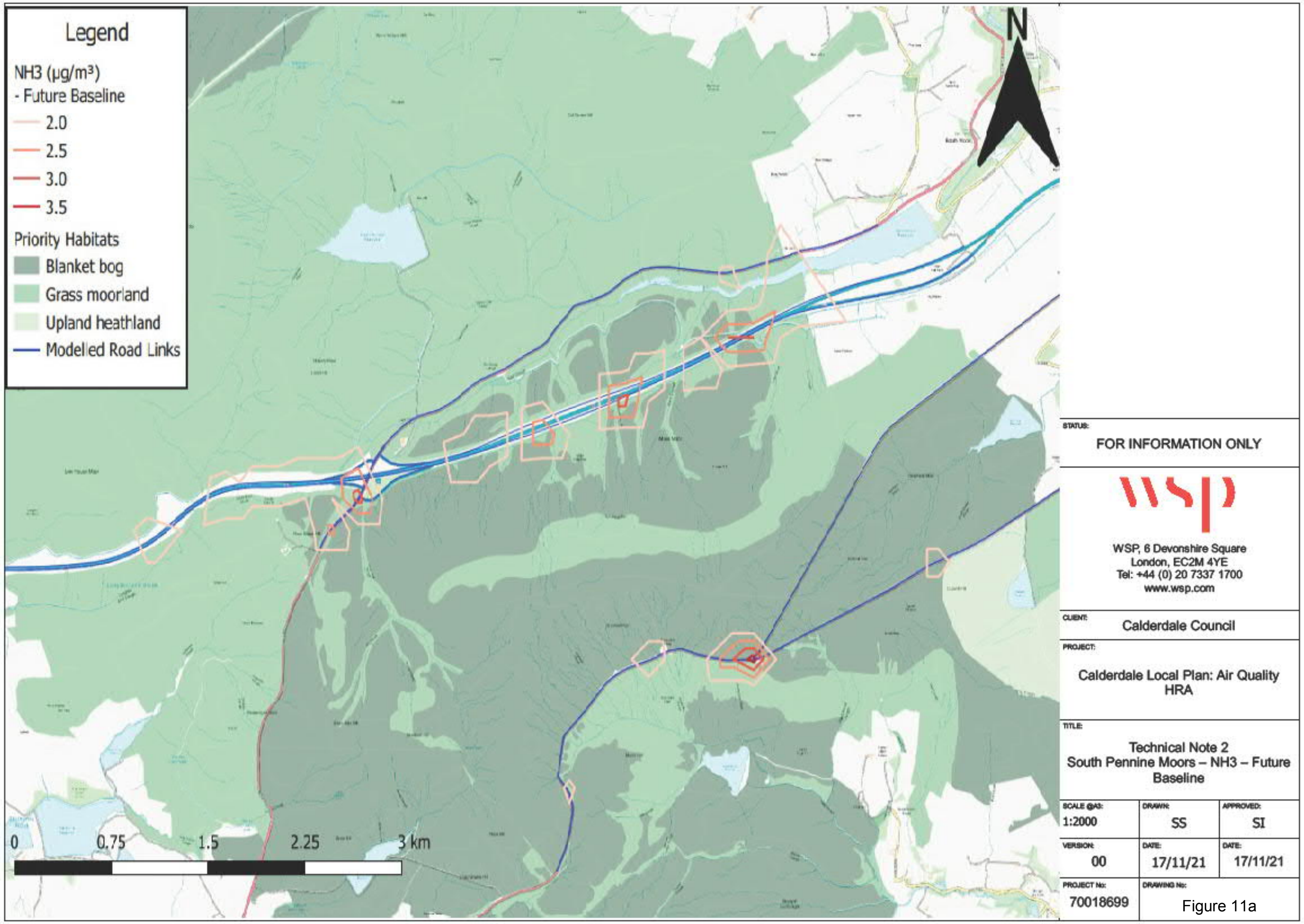
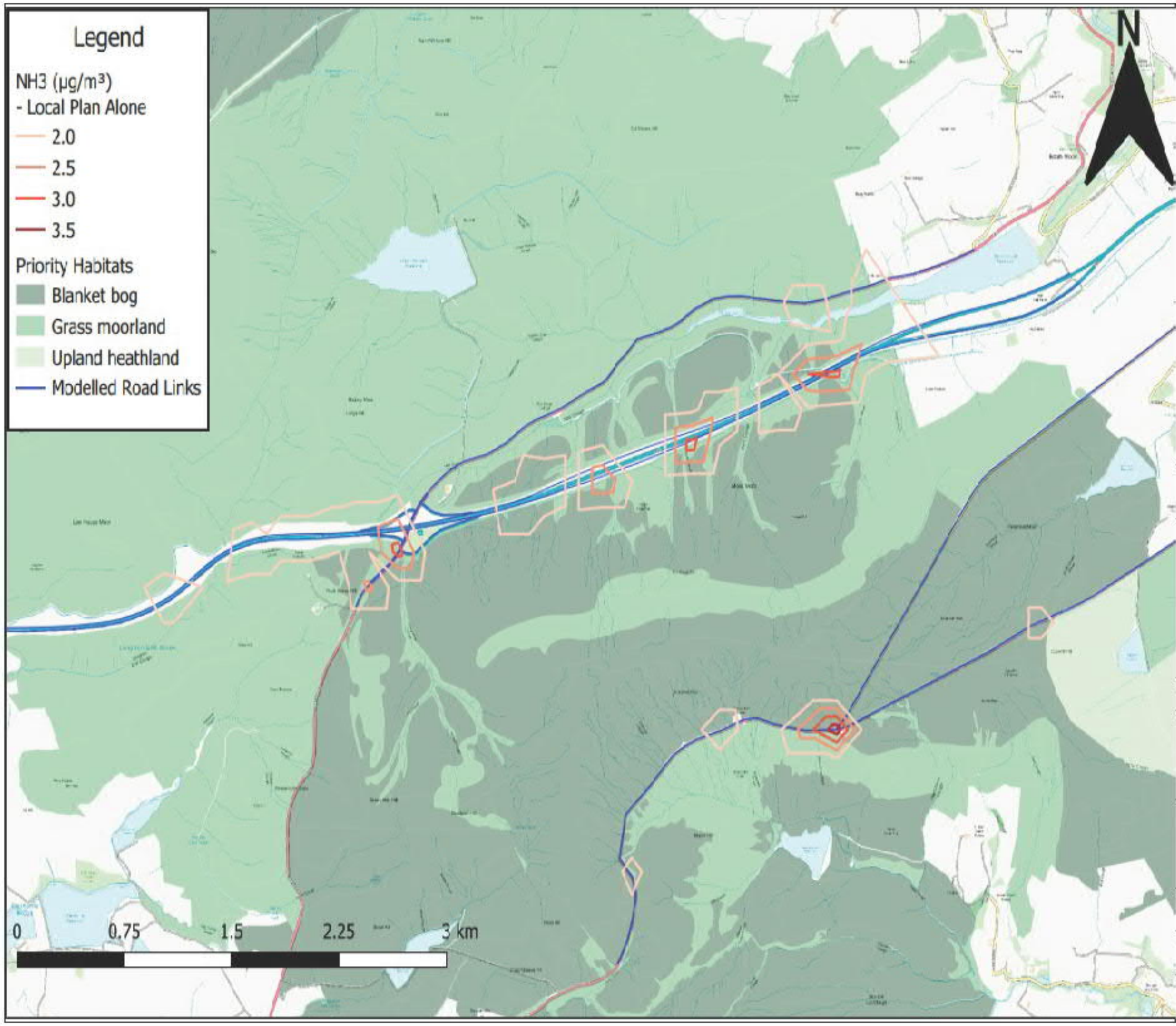

N
Legend
Change in Annual Mean NOx (µg/m³) - In Combination
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
0
0.5
1
1.5
2 km
STATUS:
FOR INFORMATION ONLY
wsp
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - NOx Change – In-combination
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 10e

Figure Series 11 – NH_3 Isopleth Maps





STATUS: FOR INFORMATION ONLY

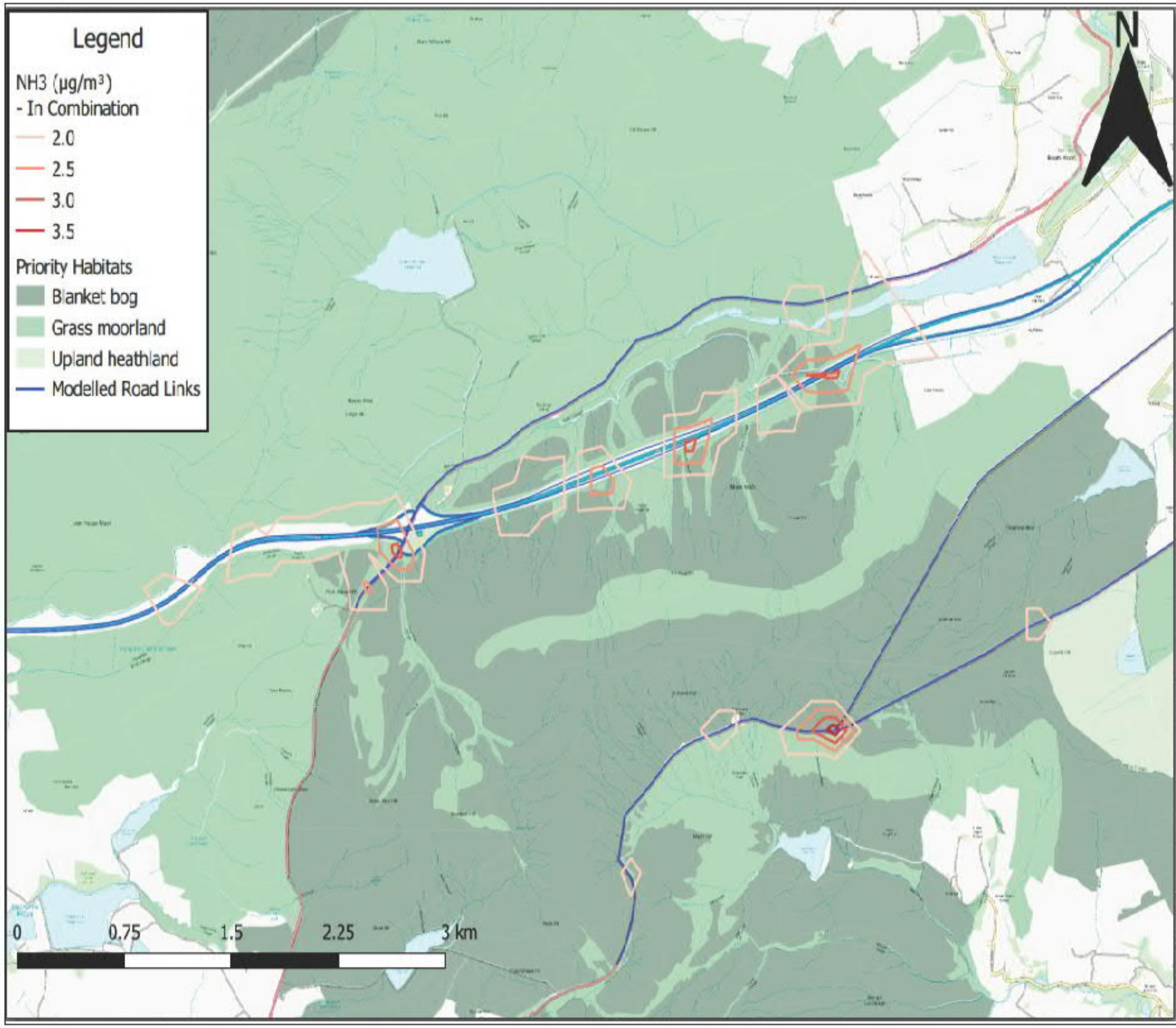
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Calderdale Council

PROJECT: Calderdale Local Plan: Air Quality HRA

TITLE: Technical Note 2 South Pennine Moors - NH3 – Local Plan Alon

SCALE @A3:	DRAWN:	APPROVED:
1:2000	SS	SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 11b	



STATUS: FOR INFORMATION ONLY

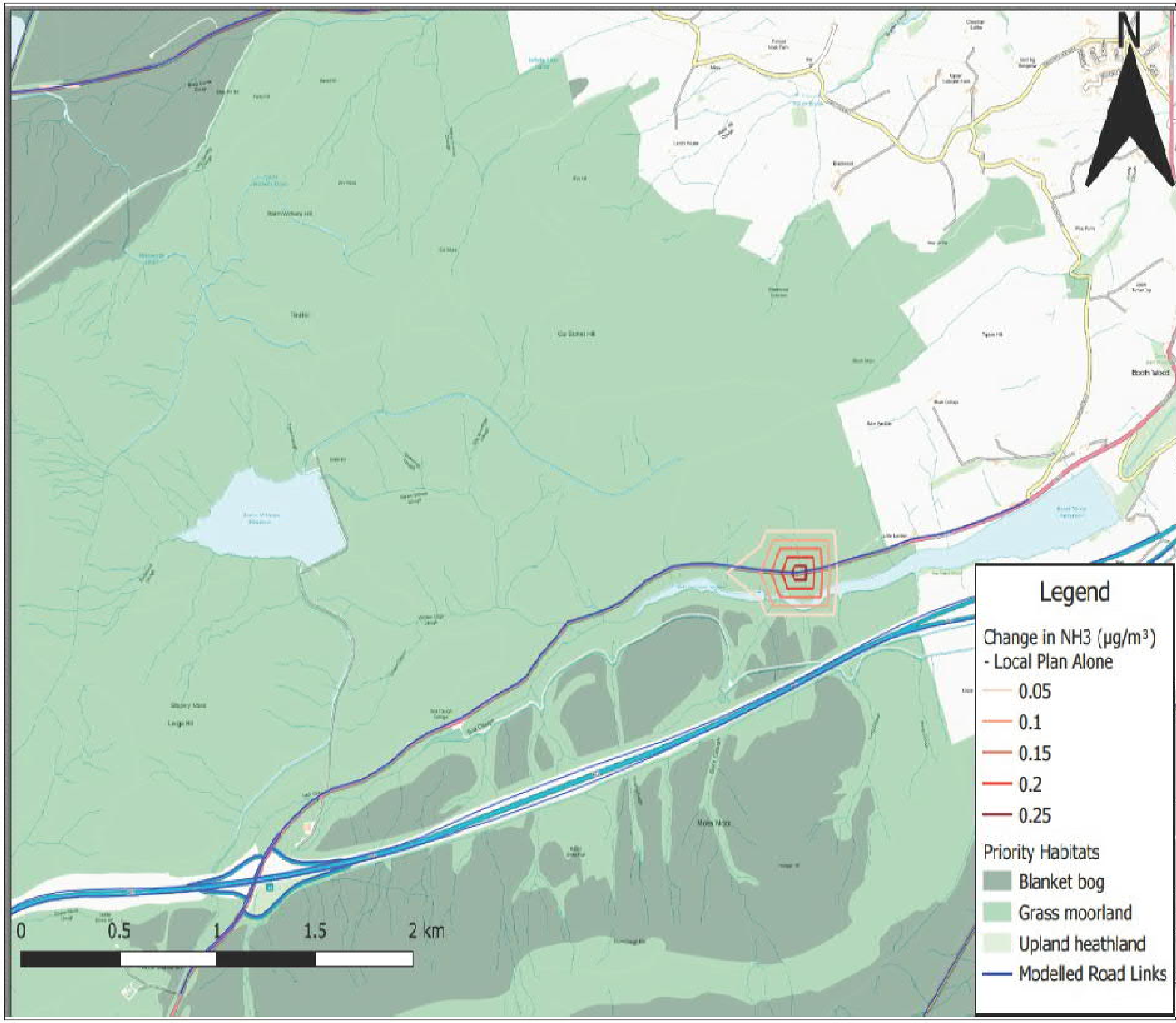
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Calderdale Council

PROJECT: Calderdale Local Plan: Air Quality HRA

TITLE: Technical Note 2
South Pennine Moors - NH3 – In-combination

SCALE @A3:	DRAWN:	APPROVED:
1:2000	SS	SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 11c	



STATUS: FOR INFORMATION ONLY

wsp

WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

CLIENT: Calderdale Council		
PROJECT: Calderdale Local Plan: Air Quality HRA		
TITLE: Technical Note 2 South Pennine Moors - NH3 Change – Local Plan Alone		
SCALE @A3: 1:2000	DRAWN: SS	APPROVED: SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 11d	

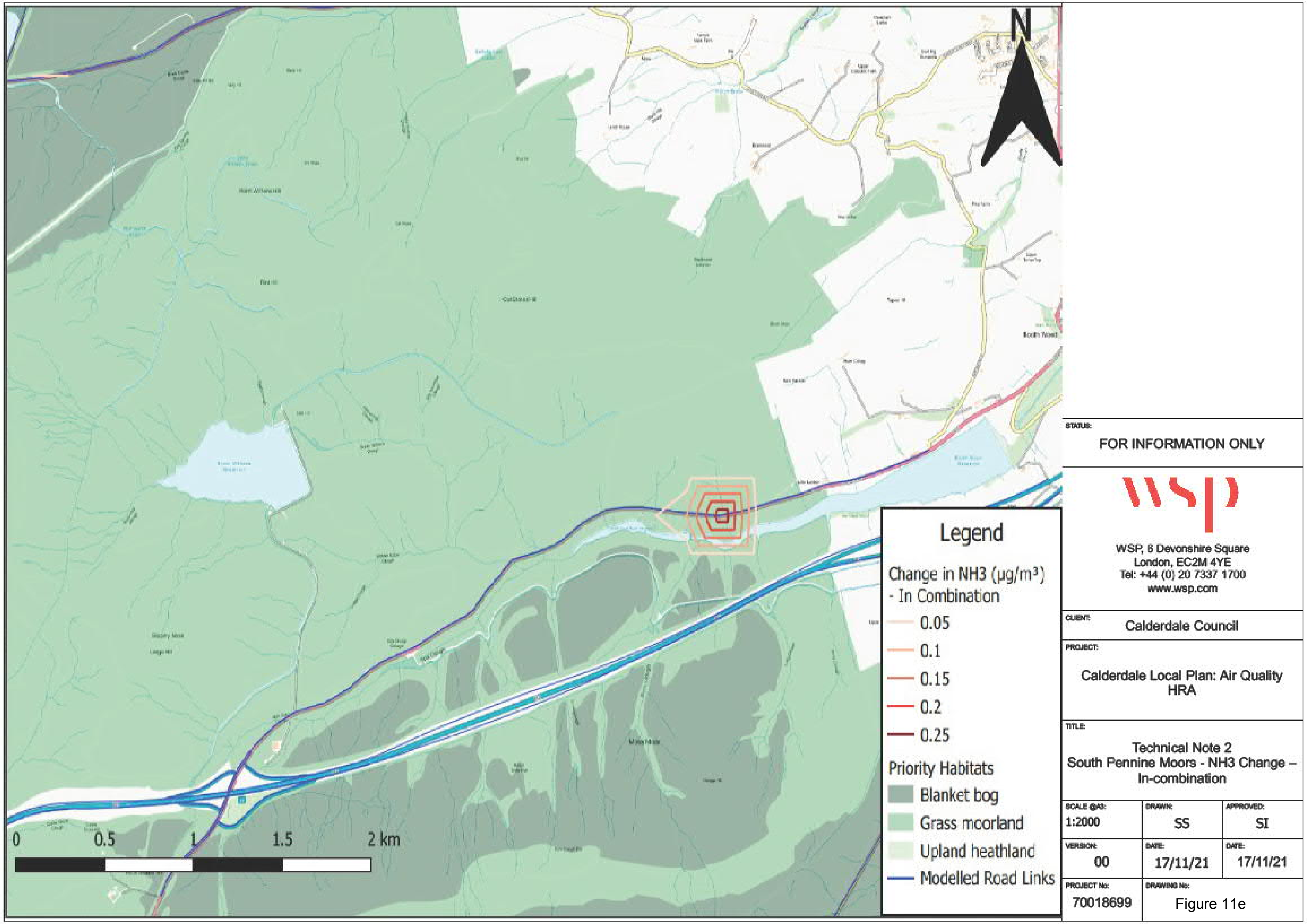
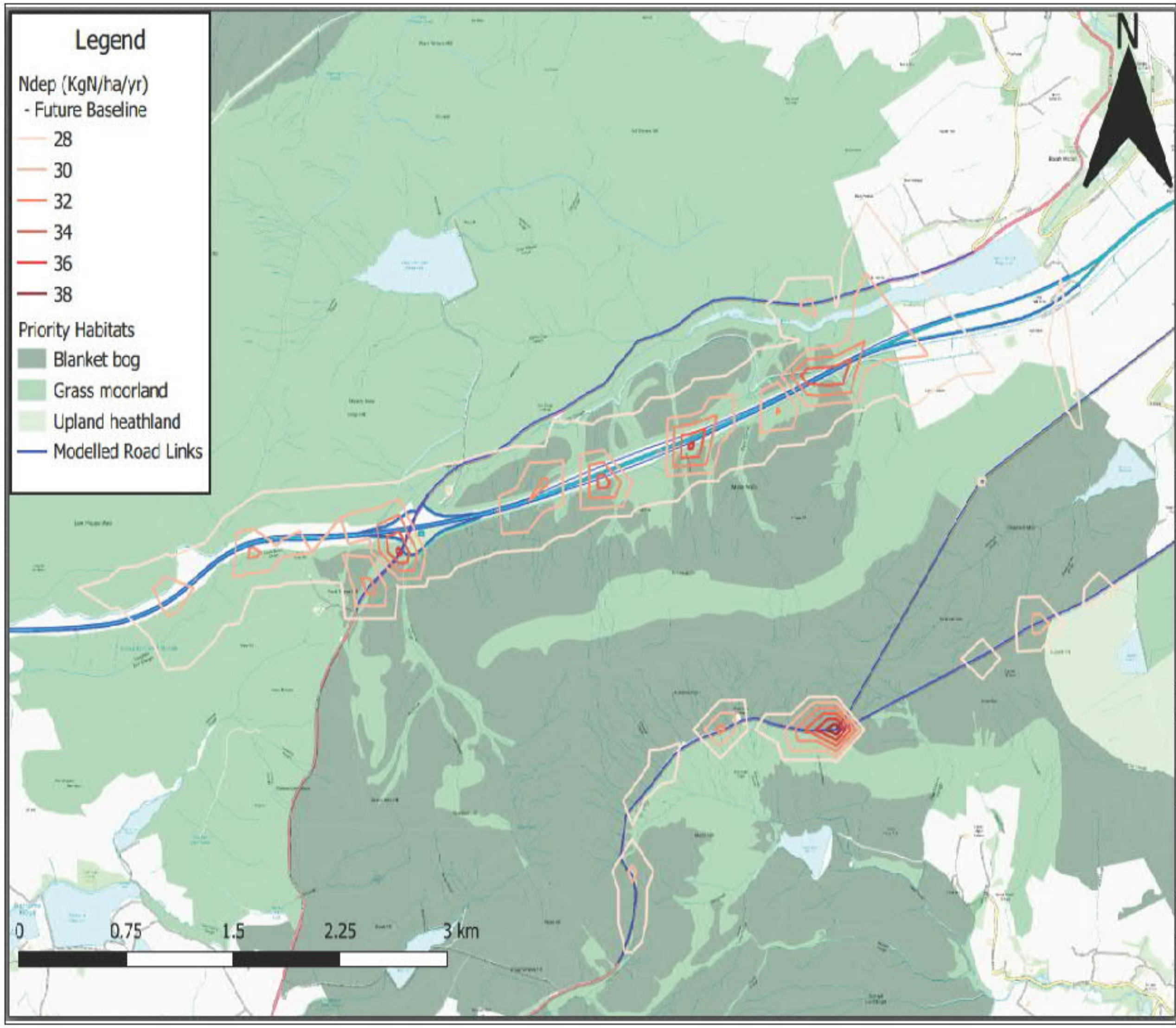

N
0
0.5
1
1.5
2 km
Legend
Change in NH3 (µg/m³) - In Combination
0.05
0.1
0.15
0.2
0.25
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - NH3 Change – In-combination
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 11e

Figure Series 12 – N-deposition Isopleth Maps



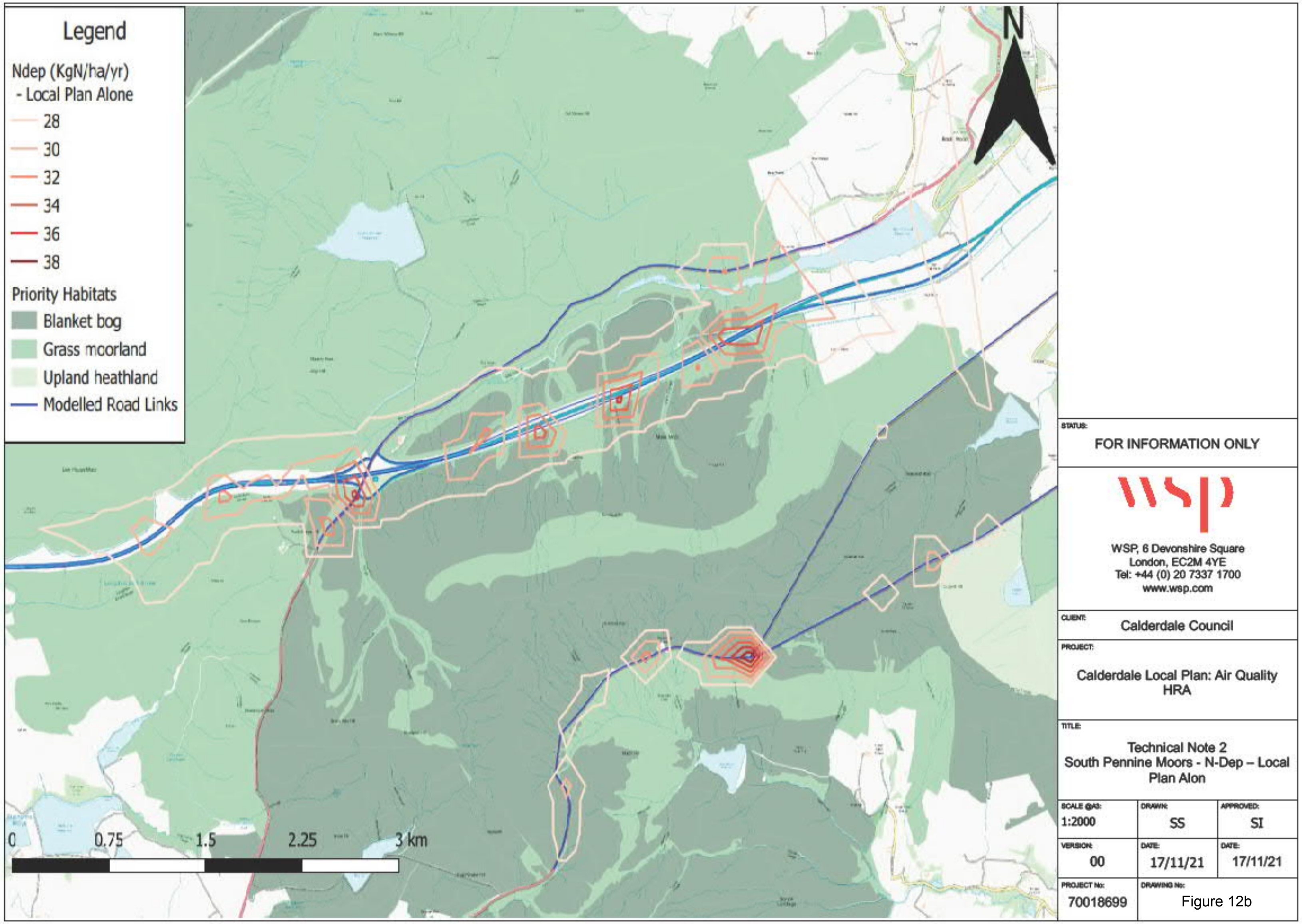
STATUS: FOR INFORMATION ONLY

wsp

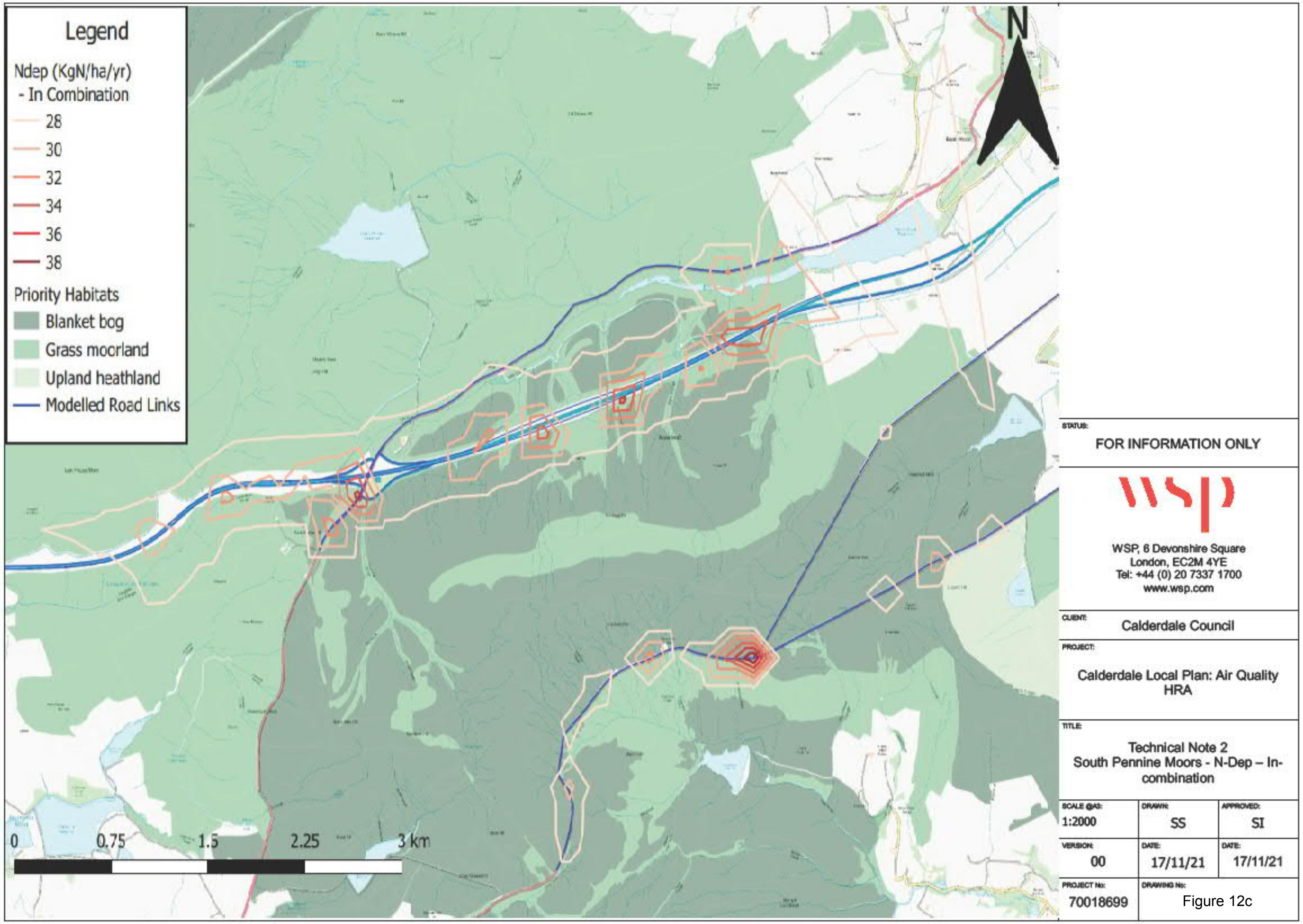
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com

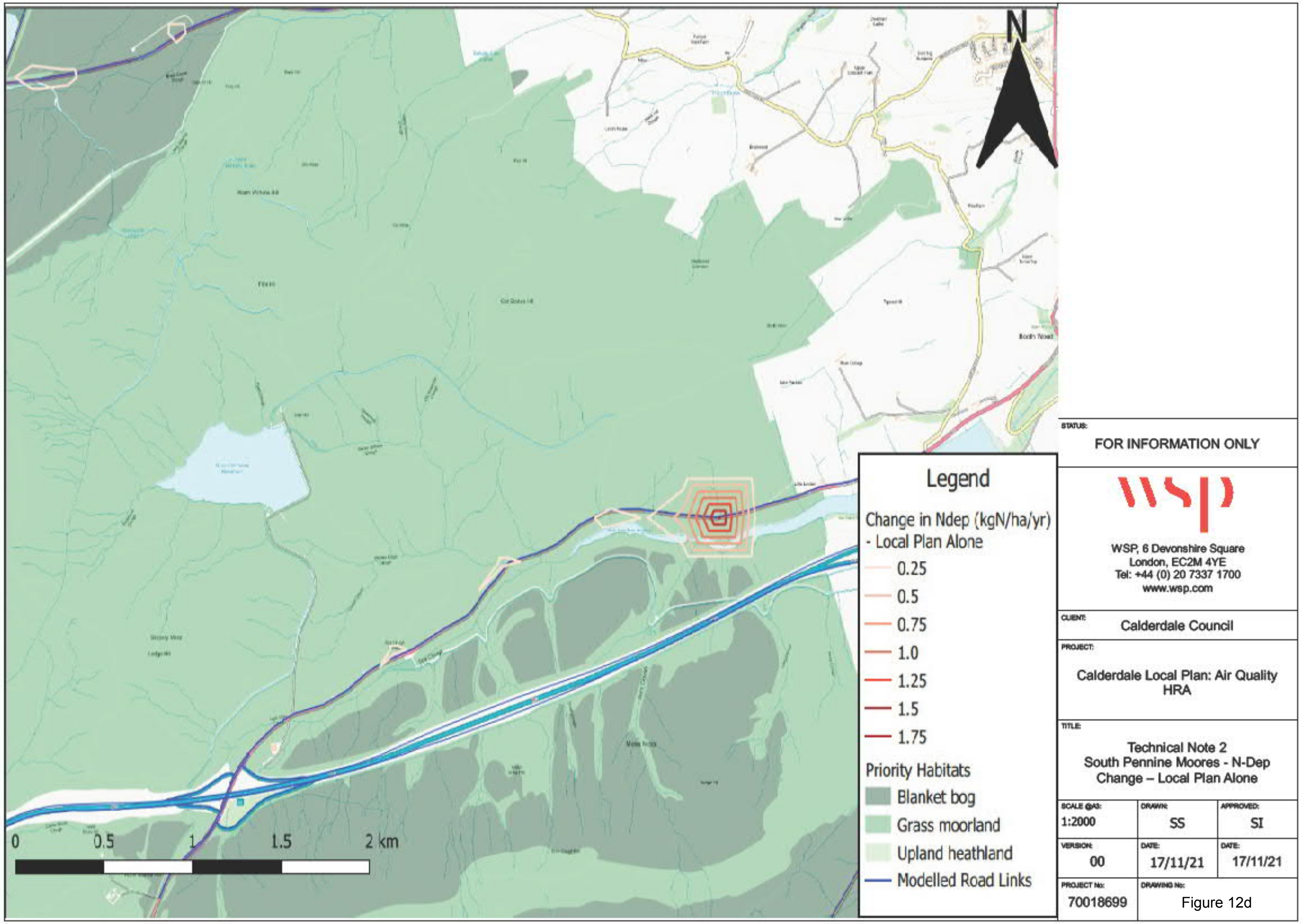
CLIENT:	Calderdale Council
PROJECT:	Calderdale Local Plan: Air Quality HRA
TITLE:	Technical Note 2 South Pennine Moors – N-Dep – Future Baseline

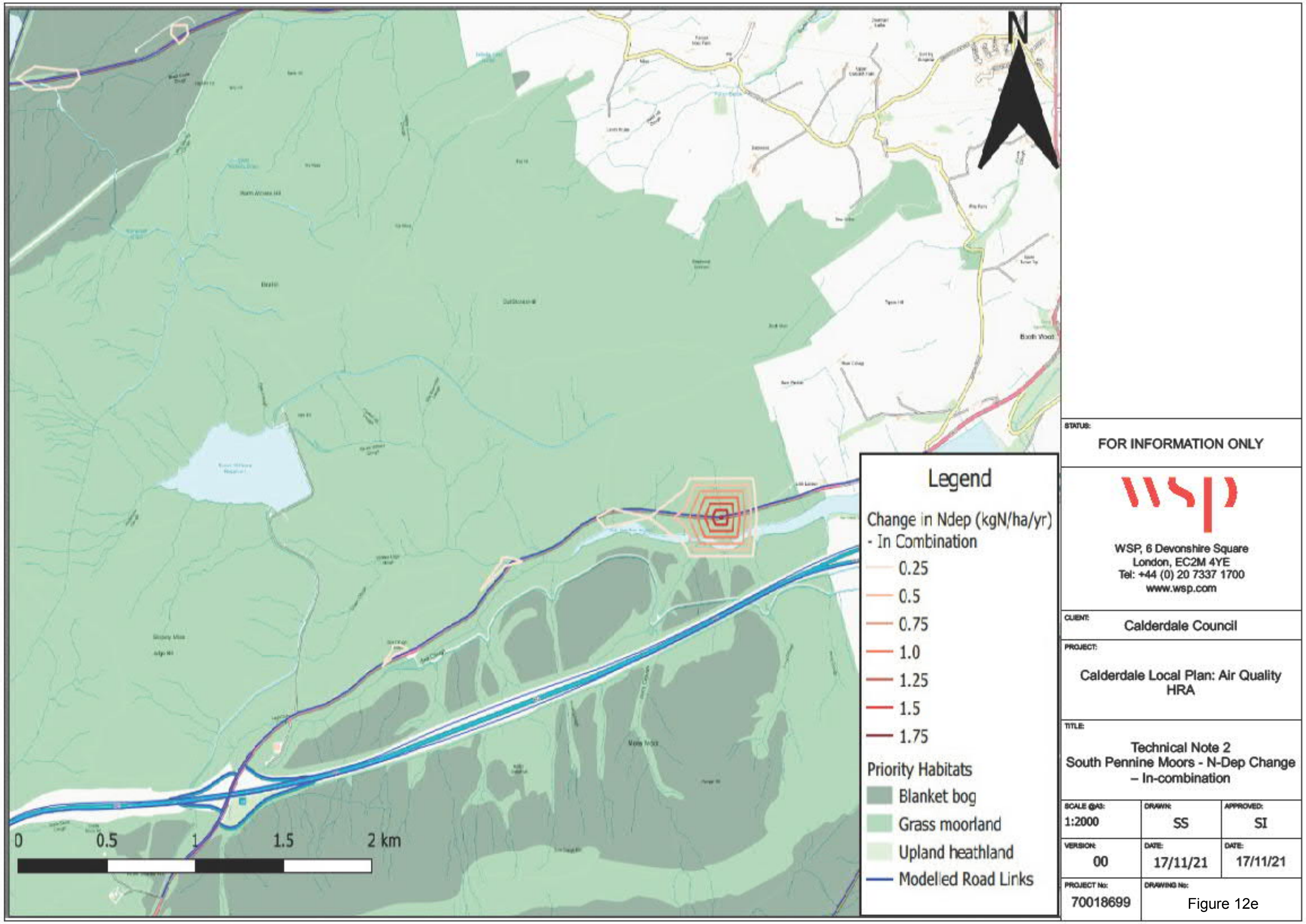
SCALE @A3:	DRAWN:	APPROVED:
1:2000	SS	SI
VERSION: 00	DATE: 17/11/21	DATE: 17/11/21
PROJECT No: 70018699	DRAWING No: Figure 12a	



Legend
Ndep (KgN/ha/yr) - Local Plan Alone
28
30
32
34
36
38
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
N
0
0.75
1.5
2.25
3 km
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - N-Dep – Local Plan Alon
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 12b


Legend
Ndep (KgN/ha/yr) - In Combination
28
30
32
34
36
38
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
0
0.75
1.5
2.25
3 km
N
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - N-Dep – In-combination
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 12c


N
0
0.5
1
1.5
2 km
Legend
Change in Ndep (kgN/ha/yr) - Local Plan Alone
0.25
0.5
0.75
1.0
1.25
1.5
1.75
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moores - N-Dep Change – Local Plan Alone
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 12d


N
0
0.5
1
1.5
2 km
Legend
Change in Ndep (kgN/ha/yr) - In Combination
0.25
0.5
0.75
1.0
1.25
1.5
1.75
Priority Habitats
Blanket bog
Grass moorland
Upland heathland
Modelled Road Links
STATUS:
FOR INFORMATION ONLY
WSP, 6 Devonshire Square
London, EC2M 4YE
Tel: +44 (0) 20 7337 1700
www.wsp.com
CLIENT:
Calderdale Council
PROJECT:
Calderdale Local Plan: Air Quality HRA
TITLE:
Technical Note 2
South Pennine Moors - N-Dep Change – In-combination
SCALE @A3:
1:2000
DRAWN:
SS
APPROVED:
SI
VERSION:
00
DATE:
17/11/21
DATE:
17/11/21
PROJECT No:
70018699
DRAWING No:
Figure 12e

Appendix A

GLOSSARY

Term	Definition
AADT Annual Average Daily Traffic	A daily total traffic flow (24 hrs), expressed as a mean daily flow across all 365 days of the year.
Affected Road Network	Specific road links identified for inclusion in a detailed air quality modelling assessment based on meeting a defined set of criteria / criterion
Air quality Objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality Objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
Conservative	Tending to over-predict the impact rather than under-predict.
Defra	Department for Environment, Food and Rural Affairs.
Exceedance	A period of time where the concentrations of a pollutant is greater than the appropriate air quality standard.
HDV/HGV	Heavy Duty Vehicle/Heavy Goods Vehicle.
LAQM	Local Air Quality Management.
Minor roads	Non A roads of Motorways.
NH_3	Ammonia
NO_x	Nitrogen oxides (comprising nitric oxide, NO and nitrogen dioxide, NO_2)
NO_2	Nitrogen dioxide
N-Deposition	Annual deposition rate of nutrient nitrogen
Road link	A length of road which is considered to have the same flow of traffic along it. Usually, a link is the road from one junction to the next.
$\mu g/m^3$ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of $1ug/m^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
kgN/ha/yr	A measure of nitrogen deposition in terms of mass (kg) per area (hectare) per year.

Appendix B

LEGISLATION, POLICY & GUIDANCE

EUROPEAN & NATIONAL LEGISLATION

The 'Habitats Directive' (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) protected habitats and species of European Sites. Together with the 'Birds Directive' (Council Directive 2009/147/EC on the Conservation of Wild Birds), the Habitats Directive established a network of internationally important sites designated for their ecological status. SACs and Sites of Conservation Interest (SCI) were designated under the Habitats Directive and promote the protection of flora, fauna, and habitats. SPAs were designated under the Birds Directive in order to protect vulnerable and migratory birds. These sites combined to create a Europe-wide 'Natura 2000' network of designated sites, referred to as 'European Sites'.

Defra guidance (2021) states that *SACs and Special Protection Areas (SPAs) in the UK no longer form part of the EU's Natura 2000 ecological network. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 have created a national site network on land and at sea, including both the inshore and offshore marine areas in the UK. The national site network includes:*

- *existing SACs and SPAs*
- *new SACs and SPAs designated under these Regulations.*

Any references to Natura 2000 in the 2017 Regulations and in guidance now refers to the new national site network.

Maintaining a coherent network of protected sites with overarching conservation objectives is still required in order to:

- fulfil the commitment made by government to maintain environmental protections
- continue to meet our international legal obligations, such as the Bern Convention, the Oslo, and Paris Conventions (OSPAR), Bonn and Ramsar Conventions

In the United Kingdom, the Habitats Regulations incorporate all SPAs into the definition of European Sites and, consequently, the protections afforded to European Sites under the Habitats Directive apply to SPAs designated under the Birds Directive.

Regulation 63 of the Habitats Regulations defines the procedure for the assessment of the implications of plans or projects on European Sites. Under this Regulation, if a proposed development is unconnected with site management and is likely to significantly affect the designated site, the competent authority must undertake an 'Appropriate Assessment'.

According to the Habitats Regulations the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be).

Regulation 63 (1) of the Habitats Regulations states that '…a competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which—

(a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and

(b) is not directly connected with or necessary to the management of that site,

—*must make an appropriate assessment of the implications for that site in view of that site's conservation objectives.'*

The Habitats Regulations make allowance for projects or plans to be completed if they satisfy 'imperative reasons of overriding public interest'39. Regulation 64 relates to such situations.

There are a number of recent Court of Justice of the European Union (CJEU) rulings which are relevant to this HRA and these are given in **Appendix B** for information. As the general provisions for the protection of European sites and the procedural requirements to undertake Habitats Regulations Appraisal (HRA) to assess the implications of plans or projects for European sites remain, this previous case law established prior to the UK's exit from the EU is considered to apply unless superseded by the judgement of an appropriate UK court.

EU DIRECTIVE ON AMBIENT AIR QUALITY DIRECTIVE (2008/50/EC)

The European Union (EU) Directive on ambient air quality (2008/50/EC)[40] is the primary driver for managing and improving air quality for each member state of the EU. The Directive sets legally binding limit values for concentrations in ambient (outdoor) air of pollutants, including NO_x and NO_2.

EU limit values are set for individual pollutants and comprise a concentration value, an averaging time over which it is to be measured, the number of allowed exceedances per year (if any), and a date by which it must be achieved.

AIR QUALITY REGULATIONS

The EU Directive has been transposed into English law through a series of Air Quality Regulations[41,42,43] the most recent being the Air Quality Standards Regulations 2016[44]. Equivalent regulations exist in the other national administrations: Scotland, Wales, and Northern Ireland.

The responsibility for meeting the prescribed air quality limit values is devolved to the national administrations. In England, the Secretary of State for Environment, Food, and Rural Affairs has responsibility for adhering to the limit values, whilst the Department for Environment, Food and Rural Affairs (Defra) co-ordinate the assessment of compliance with limit values and development of Air Quality Plans for the UK (last updated in 2017).

---

39 '*(a) reasons relating to human health, public safety or beneficial consequences of primary importance to the environment; or.*

(b) any other reasons which the competent authority, having due regard to the opinion of the Commission, consider to be imperative reasons of overriding public interest.'

40 European Parliament (2008) Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

41 The Air Quality (England) Regulations 2000 – SI 2000 No.928

42 The Air Quality (England) (Amendment) Regulations 2002 – SI 2002 No.3043

43 The Air Quality Standards Regulations 2010 – SI 2010 No.1001

44 The Air Quality Standards (Amendment) Regulations 2016 – SI 2016 No.1184

UK AIR QUALITY STRATEGY

The UK Government and the devolved administrations are required under the Environment Act 1995 to produce a national air quality strategy. The Air Quality Strategy (AQS) was last reviewed and published in 2007[45]. The AQS provides a framework for reducing air pollution in the UK and implements the Air Quality (England) Regulations 2000, setting national objectives for local authorities in England.

The AQS sets standards and objectives for nine key air pollutants to protect human health. These are benzene (C_6H_6), 1,3 butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3), and polycyclic aromatic hydrocarbons (PAHs).

In addition, the AQS has set an annual objective for oxides of nitrogen (NO_x) for the protection of vegetation and ecosystems. NO_x, comprising mainly nitrogen monoxide and NO_2, are of concern in relation to protected ecological sites, which have features that are sensitive to changes in NO_x. Objectives are also set for SO_2 and O_3, however the objective for NO_x is considered in this assessment given that the focus is on the direct impact of vehicle emissions from roads adjacent to the sensitive ecological sites.

[45] Department for Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2)

RELEVANT PLANNING POLICY CONTEXT

NATIONAL PLANNING POLICY FRAMEWORK

The Government's overall planning policies for England are described in the National Planning Policy Framework[46]. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

- '… meeting the needs of the present without compromising the ability of future generations to meet their own needs

One of the three overarching objectives of the NPPF is that planning should 'to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.'

The NPPF states that when considering the conservation and enhancement of the natural environment, with regard to habitats and biodiversity, the Local Planning Authority should:

'…protect and enhance biodiversity and geodiversity, plans should:

a) *Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and*

b) *promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.*

The following should be given the same protection as European Sites:

a) *potential Special Protection Areas and possible Special Areas of Conservation;*

b) *listed or proposed Ramsar sites; and*

c) *sites identified, or required, as compensatory measures for adverse effects on European Sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.*

The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a European Sites (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the European Sites.'

---

[46] Ministry of Housing, Communities and Local Government (February 2019). National Planning Policy Framework

It is a matter of Government policy (NPPF paragraph 118) that sites designated under the 1971 Ramsar Convention for their internationally important wetlands (commonly known as Ramsar sites) and potential SPAs (pSPA) are also considered in the same way as SACs, SPAs and cSACs.

In relation to air quality, the following paragraphs in the document are relevant:

- Paragraph 54, which states *'Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition.'*
- Paragraph 102, which relates to the need to consider transport related issues at the earliest stages of plan making and development proposals, so that *'…c) opportunities to promote walking, cycling and public transport use are identified and pursued; d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains...'.*
- Paragraph 103, which states *'Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health.*
- Paragraph 170, which states *'Planning policies and decisions should contribute to and enhance the natural and local environment by: …e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.*
- Paragraph 180, which states *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.'*
- Paragraph 181, which states *'Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.'*
- Paragraph 183, which states *'The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.'*

LOCAL PLANNING POLICY

Calderdale Local Plan Publication Draft 2018

The publication draft of the Calderdale Local Plan (2018)[47] includes a number of proposed policies that incorporate consideration of air quality, including the following:

"Policy EN2 Air Quality –

All proposals that have the potential to increase local air pollution either individually or cumulatively must be accompanied by proportionate evidence to show that the impact of the development has been assessed... Proposals that are not accompanied by that evidence or which do not incorporate adequate mitigation measures as indicated by the guidance will not be permitted.

Where the development introduces new receptors into Air Quality Management Areas the development must incorporate sustainable measures that protect the new receptors from unacceptable levels of air pollution. Where sustainable measures cannot be introduced which prevent receptors from being exposed to unacceptable levels of air pollution, development will not be permitted."

With respect to transport investment decisions, Policy IM2 states that "…*improving air quality*…" should be a key consideration as part of any transport investment application. For the natural environment, Policy GN3 of the draft Local Plan states the following:

"…*Development proposals which are likely to have a significant adverse impact on a site with one or more of the following national or international designations will not be permitted:*

i. Special Protection Areas (SPAs);

ii. Special Areas of Conservation (SACs);

iii. Sites of Special Scientific Interest (SSSI); and

iv. Sites identified, or required, as compensatory measures for adverse effects on European sites.

An ecological assessment will be required for development located within the 2.5km South Pennine Moors (phase 2) SPA & SAC buffer and outside the urban area in order to establish if the land is of functional importance to designated South Pennine Moors (phase 2) SPA species.

Any proposed development which may directly or indirectly compromise the conservation objectives of a SAC or SPA will not be permitted unless the proposal meets the conditions specified in regulation 61 and 62 of the Conservation of Habitats and Species Regulations 2010 (Habitats Regulations)."

The air quality assessment for the new Local Plan, reported herein, focusses on the potential impacts on designated sites from the change in vehicle emissions associated with the implementation of the Local Plan.

---

[47] Calderdale Council (2018) *Calderdale Local Plan Publication Draft 2018* (sourced from website, accessed April 2020: file:///C:/Users/UKDMP601/Downloads/Calderdale_Local_Plan_Publication_Draft_2018_7105887738560017386.pdf)

Calderdale Unitary Development Plan

As the new local plan is yet to be finalised, the CC Unitary Development Plan[48] remains the council's primary planning document. The Development Plan has the following policy related to air quality:

"Policy EP 1

Protection of Air Quality

Development which might cause air pollution (including from modes of transport) will only be permitted if:

1. *It would not harm the health and safety of users of the site and surrounding area; and*
2. *It would not harm the quality and enjoyment of the environment.*

Where permission is granted, appropriate conditions and/or planning obligations will be attached to ensure that air quality is maintained."

In addition to the above, the Unitary Development Plan also contains the following policy specifically related to designated sites in Calderdale:

"Policy NE 13

Protection of Sites of National Importance

Development within or in the vicinity of a Site of Special Scientific Interest or National Nature Reserve which is likely to have an adverse effect on it, directly or indirectly, will not be permitted unless the reasons for development clearly outweigh the nature conservation value of the site and the national policy to safeguard the national network of such sites. Where necessary, Environmental Impact Assessments (EIAs) will be required to accompany planning applications.

Where development is permitted the authority will make use of conditions or planning obligations to:-

i. minimise disturbance;

ii. protect and enhance the site's nature conservation value; and

iii. where damage is unavoidable, provide new or replacement habitats so that the total ecological resource remains at or above its current ecological value."

[48] Calderdale Council Replacement Unitary Development Plan, Adopted 25/08/06, Amended 3/08/09

Appendix C

DISPERSION MODEL APPROACH & VERIFICATION

DISPERSION MODEL APPROACH & VERIFICATION

INTRODUCTION

The main pollutants of concern to designated sites from road traffic are oxides of nitrogen (NO_x/NO_2), since these pollutants are most likely to approach their relevant air quality limit values in proximity to major road links.

The developments associated with the introduction of the Local Plan have the potential to change the total flow, distribution and characteristics of traffic movements on the affected road links, which would result in changes to emissions of the aforementioned pollutants. The air quality assessment was completed to predict the potential impacts of these changes on ambient pollutant concentrations at identified sensitive ecological receptors within proximity to affected roads.

The air quality conditions were described for the base year (2019) and Assessment Year (2032). In 2032, the dispersion modelling assessment considered both the ‘Without’ Local Plan and ‘With’ Local Plan scenarios.

MODELLING METHODOLOGY

ATMOSPHERIC DISPERSION MODEL

The predicted impacts on local air quality associated with changes to vehicle emissions as a result of the operation of the scheme were assessed using Cambridge Environmental Research Consultants (CERC) atmospheric dispersion modelling system for roads (ADMS-Roads v5.0).

ADMS-Roads applies advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations within the given model domain. It can predict long-term and short-term concentrations, as well as calculations of percentile concentrations.

ADMS-Roads is a validated model, developed in the UK by CERC. The model validation process includes comparisons with data from the UK's Automatic Urban Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at http://www.cerc.co.uk/environmental-software/model-validation.html.

ATMOSPHERIC DISPERSION MODELLING PROCESS

The procedures involved in undertaking the dispersion modelling assessment are outlined below:

- Collation of input data – traffic data (flows, speeds, percentage of Heavy Duty Vehicles (HDVs)), road network mapping, sensitive receptor coordinates and meteorological data;
- Input of data in to the ADMS-Roads model for the scenarios to be modelled;
- Development of emissions inventories for each pollutant to be assessed, using Defra’s emission factor toolkit (v10.0);
- Running the ADMS-Roads model for each considered scenario;
- Conversion of modelled NO_X concentrations to Road NO_2 concentrations using Defra’s NO_x-NO_2 calculator v8.1;

- Addition of Defra background concentrations to the modelled concentrations;
- Verification and adjustment of modelled road-NO_x contributions from the assessed road network through analysing the ADMS-Roads modelled road-NO_x outputs versus CC monitored road-NO_x for the base year scenario (2019);
- Analysis of changes in pollutant concentrations between the 'Without' and 'With' scenarios to assess the significance of impacts associated with the Local Plan on designated sites in CC.

TRAFFIC DATA

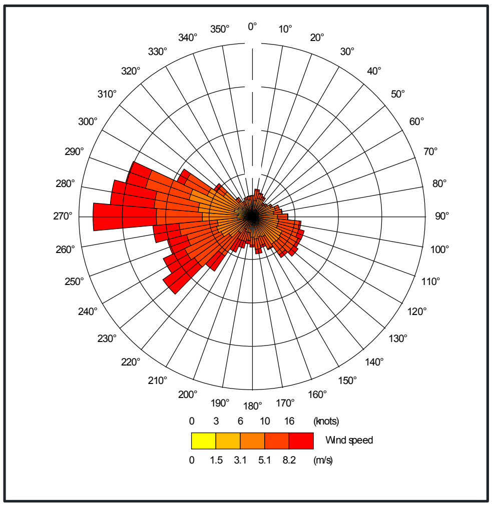
Traffic flow data comprising Annual Average Daily Traffic (AADT), traffic composition (percentage HDVs) and average link speeds (km/h) were used in the modelling as provided for the ARN by the projects transport consultant WSP. Full details of traffic flows are available on request.

METEOROLOGICAL DATA

ADMS-Roads utilises hourly sequential meteorological data; including wind direction, wind speed, temperature, precipitation and cloud cover, to facilitate the prediction of pollution dispersion between source and receptor.

Meteorological data input to the model were obtained from the closest meteorological station, Emley Moor, for the year 2019. The 2019 data was used to be consistent with the base/verification traffic year and were applied to the remaining scenarios for the air quality assessment. The 2019 wind rose is presented as **Figure C.1**.

Figure C.1 – Emley Moor 2019 Wind Rose



CONVERSION OF NO_X TO NO_2

Oxides of nitrogen (NO_x) concentrations were predicted using the ADMS-Roads model. The modelled road contribution of NO_x at the modelled receptor locations was then converted to Road NO_2 using the NO_x to NO_2 calculator (v8.1), in accordance with Defra guidance.

MODEL VERIFICATION METHODOLOGY

MODEL VALIDATION

The ADMS-Roads dispersion model has been validated for road traffic assessments and is considered to be fit for purpose. Model validation undertaken by the software developer Cambridge Environmental Research Consultants (CERC) is unlikely to have included validation in the vicinity of the scheme considered in this assessment. It is therefore necessary to perform a comparison of model results with local monitoring data at relevant locations.

MODEL VERIFICATION

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- Estimates of background pollutant concentrations;
- Meteorological data uncertainties;
- Traffic data uncertainties;
- Model input parameters, such as 'roughness length; and
- Overall limitations of the dispersion model.

Full details of the model verification process specific to the Proposed Scheme modelling assessment are provided in the 'Assessment Verification Methodology' section below.

MODEL PRECISION

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period. Suitable local monitoring data for the purpose of verification is used for model verification.

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG16 identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The statistical parameters used in this assessment are:

- Root mean square error (RMSE);
- Fractional bias (FB); and
- Correlation coefficient (CC)

A brief explanation of each statistic is provided in **Table C.1** and further details can be found in Defra's LAQM.TG16 document.

Table C.1 – Model Performance Statistics

Statistical Parameter	Comments	Ideal Value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the Objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 Objective of 40µg/m^3, if an RMSE of 10 µg/m^3 or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality Objective would be derived, which equates to 4 µg/m^3 for the annual mean NO_2 Objective.	0.0
FB	It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.0
CC	It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

The calculations were carried out after model adjustment to provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

ASSESSMENT VERIFICATION METHODOLOGY

The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results LAQM.TG (16).

Alternatively, the model may perform outside of the ideal performance limits as stated by LAQM.TG16 (i.e. model agrees within +/-25% of monitored equivalent). There is then a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process.

Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered as reasonable, then the modelled results require adjustment to best align with the monitoring data. This may either be a single verification adjustment factor to be applied to the modelled concentrations across the study area, or a range of different adjustment factors to account for different zones in the study area e.g. major roads, local roads.

The air quality model was run to predict the 2019 annual mean road-NO_x contribution at seven CC roadside diffusion tubes and one continuous monitor, located in the towns of Hebden Bridge, Mytholmroyd and Luddenden Foot. Given the rural location of the designated sites, there are no CC monitors located adjacent to the ARN of within the study area. The sites in Hebden Bridge, Mytholmroyd and Luddenden Foot are the closet monitors to the study area for which traffic data were available (traffic data from Saturn traffic model outputs).

Four other local monitoring sites were originally scoped into the model verification but were removed for the following reasons:

- Hebden Bridge (HQ1) – Results from this monitor were a lot higher than recorded at other monitors in Hebden Bridge (44µg/m^3). This was potentially due to its location next to a speed sign which would cause an increase in breaking and therefore increase in emissions. The model was unable to adequately resolve this change and, as a result, predicted concentrations were a lot lower and the monitor was removed from verification;
- Mytholmroyd (MY01) - Removed from the verification process due to its proximity to a car park, which may result in increased emissions that the model is unable to adequately resolve;
- Mytholmroyd (MY03) - Removed from the verification process as it is opposite a car park and nearby a bus stop, which may result in increased emissions that the model is unable to adequately resolve; and
- Luddenden Foot (LF1) - Removed from the verification process due to its proximity to a bus stop, which may result in increased emissions that the model is unable to adequately resolve.

The model outputs of road-NO_x have been compared with the 'measured' road-NO_x, which was determined from the NO_2 concentrations measured using diffusion tubes at the monitoring locations, utilising the NO_x from NO_2 calculator provided by Defra and the NO_2 background concentration (from the Defra background map).

The tables and figure below present the data used in the verification exercise.

Table C.2 – Data Used in Model Verification Before Adjustment

Monitoring Site ID	2019 Measured Data (µg/m^3)	Measured Road-NO_x (µg/m^3) from NO_x:NO_2 Calculator	Modelled road-NO_x (µg/m^3)- Before adjustment	Modelled Annual Mean NO_2 Concentration (µg/m^3)- Before adjustment	% Difference (Measured vs Monitored NO_2)
AQS3 - A646 adjacent to Central Street	34.3	52.7	24.0	20.5	-40.2%
HB6 – A646	30.0	42.4	21.0	19.5	-35.0%
HQ9 – A646 adjacent to Crown Street	35.0	53.3	18.7	18.3	-47.7%
LF2 – A646	29.0	39.1	16.1	17.5	-39.5%
BS1 HB - A646 adjacent to Central Street	33.0	49.9	24.0	20.5	-37.8%
MY02 – A646	21.0	23.8	11.1	14.4	-31.5%
MY04 - A646	27.0	35.9	12.9	15.4	-43.1%
MY05 - A646	28.0	37.97	14.98	16.5	-41.2%

The initial comparison between the total modelled and monitored annual mean NO_2 concentration values illustrates that the model under predicts NO_2 concentrations at all modelled locations. Therefore, verification and adjustment of modelled road-NO_x was undertaken in accordance with LAQM.TG(16) for the monitoring locations included in the verification. The calculation steps taken to adjust modelled road-NO_x are summarised in **Table C.3**, with the relationship between monitored and modelled road-NO_x concentrations at the respective monitoring locations presented in **Figure C.2**.

Figure C.3 – Comparison of Unadjusted Modelled Road-NO_x Versus Measured Road-NO_x

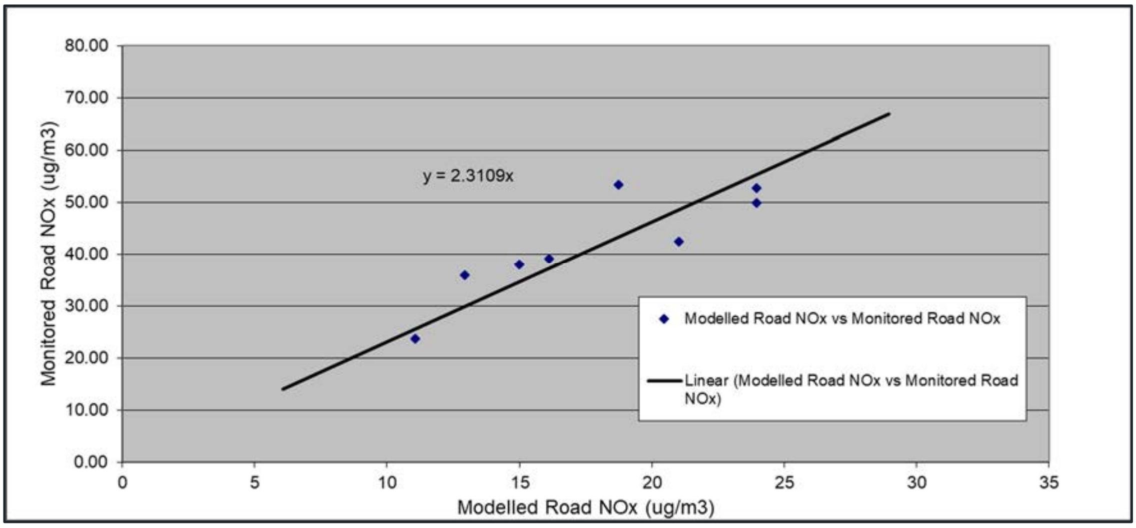


Table C.3 – Model Verification Results After Adjustment

Monitoring Site ID	2019 Measured Data (µg/m³)	Modelled Annual Mean NO_2 Concentration (µg/m³)	% Difference (Measured vs Monitored NO_2)
AQS3 - A646 adjacent to Central Street	34.3	35.5	3.4%
HB6 – A646	30.0	32.9	9.6%
HQ9 – A646 adjacent to Crown Street	35.0	30.4	-13.1%
LF2 – A646	29.0	28.1	-3.0%
BS1 HB - A646 adjacent to Central Street	33.0	35.5	7.5%
MY02 – A646	21.0	21.9	4.4%
MY04 - A646	27.0	24.1	-10.9%
MY05 - A646	28.0	26.4	-5.8%

With both road-NO_x adjustment factors applied to the modelled values, the total annual mean NO_2 concentrations derived at each location are all within +/-13.5% of the monitored equivalents, with no overall tendency for the model to under or over-predict relative to the monitored equivalents.

STATISTICAL SUMMARY

The RMSE value is considered the most useful indicator of overall model performance. The adjusted concentrations in **Table C.3** have an RMSE value of 2.5 µg/m³ which indicates that model uncertainty is within the acceptable range as per LAQM.TG16 guidance. A correlation coefficient of 0.9 was derived following adjustment of the model, indicating a near-linear relationship between the modelled and observed data. A fractional bias of 0.01 was derived, which is near to the ideal value of 0.0, demonstrating that the adjusted air quality model does not tend to over or under-predict relative to the observed data.

Appendix D

RECEPTORS EXCEEDING 1% SIGNIFICANCE CRITERION (ALL SCENARIOS)

Public

Table D-1 – Transect receptors within South Pennine Moors with a magnitude of change in annual mean NO_x concentrations of ≥1% of benchmark (2032)

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NO_x (µg/m³)				Change in Annual Mean NO_x (µg/m³)		Magnitude of change as % of Benchmark (30 µg/m³)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
85 - 5	0	32.7	14.4	16.6	16.6	2.2	2.3	7.5%	7.5%
86 - 5	10	32.8	14.9	16.2	16.2	1.2	1.3	4.2%	4.2%
87 - 5	20	31.1	14.4	15.3	15.3	0.9	0.9	3.0%	3.0%
88 - 5	30	30.2	14.1	14.8	14.8	0.7	0.7	2.3%	2.3%
89 - 5	40	29.7	14.0	14.6	14.6	0.6	0.6	1.9%	1.9%
90 - 5	50	29.4	13.9	14.4	14.4	0.5	0.5	1.6%	1.6%
91 - 5	60	29.3	13.9	14.3	14.3	0.4	0.4	1.4%	1.4%
92 - 5	70	29.3	13.9	14.2	14.3	0.4	0.4	1.2%	1.3%
93 - 5	80	29.3	13.9	14.2	14.2	0.3	0.3	1.1%	1.1%
94 - 5	90	29.3	13.9	14.2	14.2	0.3	0.3	1.0%	1.0%
106 - 6	0	34.5	15.4	17.4	17.4	2.0	2.0	6.7%	6.7%
107 - 6	10	29.9	14.0	15.1	15.1	1.1	1.1	3.7%	3.8%
108 - 6	20	28.2	13.5	14.3	14.3	0.8	0.8	2.7%	2.7%
109 - 6	30	27.3	13.2	13.8	13.8	0.6	0.6	2.1%	2.1%
110 - 6	40	26.6	13.0	13.5	13.5	0.5	0.5	1.7%	1.7%
111 - 6	50	26.1	12.9	13.3	13.3	0.4	0.4	1.5%	1.5%
112 - 6	60	25.8	12.8	13.1	13.1	0.4	0.4	1.3%	1.3%
113 - 6	70	25.5	12.7	13.0	13.0	0.3	0.3	1.1%	1.1%

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NOx (µg/m³)				Change in Annual Mean NOx (µg/m³)		Magnitude of change as % of Benchmark (30 µg/m³)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone *(Sc. 3 – Sc. 2)*	Impact of Local Plan In-combination *(Sc. 4 – Sc. 2)*	Local Plan Alone *(Sc. 3 – Sc. 2)*	Local Plan In-combination *(Sc. 4 – Sc. 2)*
114 - 6	80	17.6	9.6	9.9	9.9	0.3	0.3	1.0%	1.0%
142 - 8	20	86.7	33.5	34.1	34.1	0.6	0.6	2.0%	2.0%
143 - 8	30	72.7	29.1	29.6	29.6	0.5	0.5	1.6%	1.6%
144 - 8	40	63.7	26.3	26.7	26.7	0.4	0.4	1.3%	1.4%
145 - 8	50	57.3	24.3	24.6	24.6	0.3	0.4	1.2%	1.2%
146 - 8	60	52.6	22.7	23.0	23.1	0.3	0.3	1.0%	1.0%
161 - 9	0	55.2	19.2	19.5	19.5	0.3	0.3	1.1%	1.1%
182 - 10	0	52.4	18.5	18.8	18.8	0.3	0.3	1.0%	1.0%
287 - 15	0	19.5	11.3	12.1	12.1	0.8	0.8	2.6%	2.7%
288 - 15	10	16.3	10.0	10.5	10.5	0.5	0.5	1.7%	1.7%
289 - 15	20	14.8	9.4	9.8	9.8	0.4	0.4	1.3%	1.3%
290 - 15	30	14.0	9.1	9.4	9.4	0.3	0.3	1.0%	1.0%
308 - 16	0	21.1	11.3	12.3	12.3	0.9	0.9	3.1%	3.1%
309 - 16	10	16.4	9.5	10.0	10.0	0.5	0.5	1.7%	1.7%
310 - 16	20	14.6	8.8	9.1	9.1	0.4	0.4	1.2%	1.2%
329 - 17	0	18.5	10.2	11.1	11.1	0.9	0.9	2.9%	2.9%
330 - 17	10	15.1	8.9	9.4	9.4	0.5	0.5	1.7%	1.7%
331 - 17	30	13.8	8.3	8.7	8.7	0.4	0.4	1.2%	1.2%

[1] – Without Calderdale Local Plan   [2] – With Calderdale Local Plan   [3] – Calderdale Local Plan + Emerging Bradford Plan   Note: All 2032 scenarios based on 2030 vehicle emissions factors

Table D-2 – Transect receptors within South Pennine Moors with a magnitude of change in annual mean NH_3 concentrations of ≥1% of benchmark (2032)

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NH_3 (µg/m^3)				Change in Annual Mean NH_3 (µg/m^3)		Magnitude of change as % of Benchmark (1 µg/m^3)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
1 - 1	0	3.55	4.46	4.48	4.48	0.0	0.0	1.9%	1.9%
2 - 1	10	2.88	3.49	3.50	3.50	0.0	0.0	1.2%	1.3%
3 - 1	20	2.53	2.98	2.99	2.99	0.0	0.0	1.0%	1.0%
19 - 1	180	1.72	1.81	1.82	1.82	0.0	0.0	1.1%	1.1%
20 - 1	190	1.71	1.80	1.81	1.81	0.0	0.0	1.2%	1.2%
21 - 1	200	1.71	1.79	1.80	1.80	0.0	0.0	1.3%	1.3%
64 - 4	0	2.77	3.32	3.33	3.34	0.0	0.0	1.0%	1.0%
85 - 5	0	1.85	1.92	2.09	2.09	0.2	0.2	16.8%	16.9%
86 - 5	10	1.72	1.78	1.86	1.86	0.1	0.1	8.4%	8.5%
87 - 5	20	1.68	1.73	1.78	1.78	0.1	0.1	5.6%	5.6%
88 - 5	30	1.66	1.71	1.75	1.75	0.0	0.0	4.1%	4.1%
89 - 5	40	1.65	1.69	1.73	1.73	0.0	0.0	3.2%	3.3%
90 - 5	50	1.64	1.69	1.71	1.71	0.0	0.0	2.6%	2.7%
91 - 5	60	1.64	1.68	1.71	1.71	0.0	0.0	2.2%	2.3%
92 - 5	70	1.64	1.68	1.70	1.70	0.0	0.0	1.9%	1.9%
93 - 5	80	1.64	1.68	1.70	1.70	0.0	0.0	1.7%	1.7%
94 - 5	90	1.64	1.68	1.70	1.70	0.0	0.0	1.5%	1.5%
95 - 5	100	1.64	1.68	1.70	1.70	0.0	0.0	1.4%	1.4%

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NH_3 (µg/m^3)				Change in Annual Mean NH_3 (µg/m^3)		Magnitude of change as % of Benchmark (1 µg/m^3)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
96 - 5	110	1.64	1.69	1.70	1.70	0.0	0.0	1.3%	1.3%
97 - 5	120	1.64	1.69	1.70	1.70	0.0	0.0	1.1%	1.2%
98 - 5	130	1.64	1.69	1.70	1.70	0.0	0.0	1.1%	1.1%
106 - 6	0	1.79	1.85	2.00	2.00	0.1	0.1	14.9%	15.0%
107 - 6	10	1.68	1.72	1.80	1.80	0.1	0.1	7.6%	7.6%
108 - 6	20	1.64	1.68	1.73	1.73	0.1	0.1	5.1%	5.1%
109 - 6	30	1.62	1.65	1.69	1.69	0.0	0.0	3.8%	3.8%
110 - 6	40	1.61	1.64	1.67	1.67	0.0	0.0	3.0%	3.0%
111 - 6	50	1.60	1.63	1.65	1.65	0.0	0.0	2.5%	2.5%
112 - 6	60	1.60	1.62	1.64	1.64	0.0	0.0	2.1%	2.1%
113 - 6	70	1.59	1.61	1.63	1.63	0.0	0.0	1.8%	1.8%
114 - 6	80	1.59	1.61	1.62	1.62	0.0	0.0	1.6%	1.6%
115 - 6	90	1.58	1.60	1.62	1.62	0.0	0.0	1.4%	1.4%
116 - 6	100	1.58	1.60	1.61	1.61	0.0	0.0	1.3%	1.3%
117 - 6	110	1.58	1.60	1.61	1.61	0.0	0.0	1.1%	1.2%
118 - 6	120	1.58	1.60	1.61	1.61	0.0	0.0	1.0%	1.0%
127 - 7	60	1.98	2.15	2.17	2.17	0.0	0.0	1.0%	1.0%
142 - 8	20	2.68	3.13	3.15	3.15	0.0	0.0	2.9%	2.9%
143 - 8	30	2.41	2.75	2.78	2.78	0.0	0.0	2.2%	2.2%
144 - 8	40	2.24	2.52	2.54	2.54	0.0	0.0	1.8%	1.8%

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NH_3 (µg/m³)				Change in Annual Mean NH_3 (µg/m³)		Magnitude of change as % of Benchmark (1 µg/m³)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
145 - 8	50	2.12	2.36	2.37	2.37	0.0	0.0	1.5%	1.5%
146 - 8	60	2.04	2.24	2.25	2.25	0.0	0.0	1.3%	1.3%
147 - 8	70	1.97	2.15	2.16	2.16	0.0	0.0	1.1%	1.1%
148 - 8	80	1.92	2.08	2.09	2.09	0.0	0.0	1.0%	1.0%
161 - 9	0	2.47	2.51	2.53	2.53	0.0	0.0	2.2%	2.2%
162 - 9	10	2.05	2.07	2.08	2.08	0.0	0.0	1.2%	1.2%
182 - 10	0	2.35	2.39	2.40	2.41	0.0	0.0	1.9%	2.0%
183 - 10	10	1.99	2.01	2.02	2.02	0.0	0.0	1.1%	1.1%
223 - 11	200	1.68	1.70	1.71	1.71	0.0	0.0	1.2%	1.3%
245 - 13	0	1.70	1.73	1.74	1.74	0.0	0.0	1.6%	1.7%
266 - 14	0	1.70	1.72	1.74	1.74	0.0	0.0	1.5%	1.6%
287 - 15	0	1.73	1.84	1.91	1.91	0.1	0.1	6.8%	6.8%
288 - 15	10	1.65	1.71	1.75	1.75	0.0	0.0	4.0%	4.1%
289 - 15	20	1.61	1.66	1.69	1.69	0.0	0.0	2.9%	2.9%
290 - 15	30	1.59	1.63	1.65	1.65	0.0	0.0	2.2%	2.2%
291 - 15	40	1.58	1.61	1.63	1.63	0.0	0.0	1.8%	1.8%
292 - 15	50	1.57	1.60	1.61	1.61	0.0	0.0	1.5%	1.5%
293 - 15	60	1.56	1.59	1.60	1.60	0.0	0.0	1.3%	1.3%
294 - 15	70	1.56	1.58	1.59	1.59	0.0	0.0	1.1%	1.1%
295 - 15	80	1.56	1.57	1.58	1.58	0.0	0.0	1.0%	1.0%

Receptor ID – Transect No.	Distance from designated site boundary (m)	Annual Mean NH_3 (µg/m^3)				Change in Annual Mean NH_3 (µg/m^3)		Magnitude of change as % of Benchmark (1 µg/m^3)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
308 - 16	0	1.76	1.88	1.96	1.96	0.1	0.1	7.7%	7.7%
309 - 16	10	1.64	1.70	1.74	1.74	0.0	0.0	3.8%	3.8%
310 - 16	20	1.60	1.64	1.66	1.66	0.0	0.0	2.5%	2.5%
311 - 16	30	1.58	1.61	1.63	1.63	0.0	0.0	1.8%	1.8%
312 - 16	40	1.57	1.59	1.61	1.61	0.0	0.0	1.5%	1.5%
313 - 16	50	1.56	1.58	1.59	1.59	0.0	0.0	1.2%	1.2%
314 - 16	60	1.56	1.57	1.58	1.58	0.0	0.0	1.0%	1.0%
329 - 17	0	1.71	1.80	1.88	1.88	0.1	0.1	7.3%	7.3%
330 - 17	10	1.62	1.67	1.71	1.71	0.0	0.0	3.9%	3.9%
331 - 17	30	1.59	1.63	1.65	1.65	0.0	0.0	2.6%	2.6%
332 - 17	40	1.57	1.60	1.62	1.62	0.0	0.0	1.9%	1.9%
333 - 17	40	1.56	1.58	1.60	1.60	0.0	0.0	1.5%	1.5%
334 - 17	50	1.56	1.57	1.59	1.59	0.0	0.0	1.2%	1.3%
335 - 17	60	1.55	1.57	1.58	1.58	0.0	0.0	1.0%	1.1%
392 - 20	0	1.56	1.60	1.61	1.61	0.0	0.0	1.7%	1.7%
413 - 21	0	1.57	1.61	1.63	1.63	0.0	0.0	1.9%	1.9%
414 - 21	10	1.55	1.57	1.58	1.58	0.0	0.0	1.1%	1.1%

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan Note: All 2032 scenarios based on 2030 vehicle emissions factors

Note: APIS Annual Mean NH_3 background (1.5 µg/m^3)

Table D-3 – Transect receptors within South Pennine Moors with a magnitude of change in N-Deposition of >1% of benchmark (2032)

Receptor ID – Transect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
1 - 1	0	43.6	44.2	44.3	44.3	0.1	0.1	2.3%	2.4%
2 - 1	10	38.5	38.5	38.6	38.6	0.1	0.1	1.6%	1.7%
3 - 1	20	35.8	35.5	35.6	35.6	0.1	0.1	1.3%	1.3%
4 - 1	30	34.1	33.8	33.8	33.8	0.1	0.1	1.1%	1.2%
5 - 1	40	33.0	32.6	32.6	32.6	0.1	0.1	1.0%	1.0%
11 - 1	100	30.1	29.7	29.7	29.7	0.0	0.1	1.0%	1.0%
12 - 1	110	29.9	29.5	29.5	29.5	0.1	0.1	1.0%	1.0%
13 - 1	120	29.7	29.2	29.3	29.3	0.1	0.1	1.0%	1.0%
14 - 1	130	29.5	29.1	29.1	29.1	0.1	0.1	1.1%	1.1%
15 - 1	140	29.3	28.9	29.0	29.0	0.1	0.1	1.1%	1.1%
16 - 1	150	29.2	28.8	28.9	28.9	0.1	0.1	1.2%	1.2%
17 - 1	160	29.1	28.7	28.7	28.7	0.1	0.1	1.3%	1.3%
18 - 1	170	29.0	28.6	28.7	28.7	0.1	0.1	1.4%	1.4%
19 - 1	180	28.9	28.5	28.6	28.6	0.1	0.1	1.4%	1.5%
20 - 1	190	28.8	28.4	28.5	28.5	0.1	0.1	1.6%	1.6%
21 - 1	200	28.7	28.3	28.4	28.4	0.1	0.1	1.7%	1.7%
64 - 4	0	37.5	37.5	37.6	37.6	0.1	0.1	1.3%	1.3%
85 - 5	0	29.7	29.1	30.2	30.2	1.0	1.0	20.8%	20.9%

Receptor ID – Transect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
86 - 5	10	28.6	28.2	28.8	28.8	0.5	0.5	10.6%	10.7%
87 - 5	20	28.3	28.0	28.3	28.3	0.4	0.4	7.1%	7.2%
88 - 5	30	28.1	27.8	28.1	28.1	0.3	0.3	5.3%	5.3%
89 - 5	40	28.0	27.8	28.0	28.0	0.2	0.2	4.2%	4.2%
90 - 5	50	28.0	27.7	27.9	27.9	0.2	0.2	3.5%	3.5%
91 - 5	60	28.0	27.7	27.8	27.8	0.1	0.1	2.9%	3.0%
92 - 5	70	28.0	27.7	27.8	27.8	0.1	0.1	2.6%	2.6%
93 - 5	80	27.9	27.7	27.8	27.8	0.1	0.1	2.3%	2.3%
94 - 5	90	28.0	27.7	27.8	27.8	0.1	0.1	2.0%	2.1%
95 - 5	100	28.0	27.7	27.8	27.8	0.1	0.1	1.9%	1.9%
96 - 5	110	28.0	27.7	27.8	27.8	0.1	0.1	1.7%	1.7%
97 - 5	120	28.0	27.7	27.8	27.8	0.1	0.1	1.6%	1.6%
98 - 5	130	28.0	27.8	27.8	27.8	0.1	0.1	1.4%	1.4%
99 - 5	140	28.1	27.8	27.9	27.9	0.1	0.1	1.4%	1.4%
100 - 5	150	28.1	27.8	27.9	27.9	0.1	0.1	1.3%	1.3%
101 - 5	160	28.1	27.9	27.9	27.9	0.1	0.1	1.2%	1.2%
102 - 5	170	28.2	27.9	28.0	28.0	0.1	0.1	1.1%	1.2%
103 - 5	180	28.2	27.9	28.0	28.0	0.1	0.1	1.1%	1.1%
104 - 5	190	28.3	28.0	28.0	28.0	0.1	0.1	1.0%	1.1%
106 - 6	0	29.1	28.7	29.6	29.6	0.9	0.9	18.4%	18.6%

Receptor ID – Transect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
107 - 6	10	28.2	27.9	28.4	28.4	0.5	0.5	9.6%	9.6%
108 - 6	20	27.9	27.6	27.9	27.9	0.3	0.3	6.5%	6.5%
109 - 6	30	27.7	27.5	27.7	27.7	0.2	0.2	4.9%	5.0%
110 - 6	40	27.6	27.4	27.6	27.6	0.2	0.2	3.9%	3.9%
111 - 6	50	27.5	27.3	27.5	27.5	0.2	0.2	3.2%	3.2%
112 - 6	60	27.5	27.3	27.4	27.4	0.1	0.1	2.8%	2.8%
113 - 6	70	27.4	27.2	27.4	27.4	0.1	0.1	2.4%	2.4%
114 - 6	80	27.4	27.2	27.3	27.3	0.1	0.1	2.1%	2.1%
115 - 6	90	27.4	27.2	27.3	27.3	0.1	0.1	1.9%	1.9%
116 - 6	100	27.3	27.2	27.2	27.2	0.1	0.1	1.7%	1.7%
117 - 6	110	27.3	27.1	27.2	27.2	0.1	0.1	1.5%	1.6%
118 - 6	120	27.3	27.1	27.2	27.2	0.1	0.1	1.4%	1.4%
119 - 6	130	27.3	27.1	27.2	27.2	0.1	0.1	1.3%	1.3%
120 - 6	140	27.3	27.1	27.2	27.2	0.1	0.1	1.2%	1.2%
121 - 6	150	27.2	27.1	27.1	27.1	0.1	0.1	1.1%	1.1%
122 - 6	160	27.2	27.1	27.1	27.1	0.1	0.1	1.0%	1.1%
123 - 6	170	27.2	27.1	27.1	27.1	0.0	0.1	1.0%	1.0%
127 - 7	60	31.2	30.7	30.7	30.7	0.1	0.1	1.5%	1.5%
128 - 7	70	30.7	30.2	30.2	30.2	0.1	0.1	1.3%	1.3%
129 - 7	80	30.3	29.8	29.8	29.8	0.1	0.1	1.2%	1.2%

Receptor ID – Transcect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
130 - 7	90	30.0	29.5	29.5	29.5	0.1	0.1	1.1%	1.1%
131 - 7	100	29.7	29.2	29.3	29.3	0.1	0.1	1.0%	1.0%
142 - 8	20	37.2	36.5	36.7	36.7	0.2	0.2	3.8%	3.9%
143 - 8	30	35.0	34.3	34.4	34.4	0.1	0.1	3.0%	3.0%
144 - 8	40	33.5	32.9	33.0	33.0	0.1	0.1	2.4%	2.5%
145 - 8	50	32.5	31.9	32.0	32.0	0.1	0.1	2.1%	2.1%
146 - 8	60	31.8	31.2	31.3	31.3	0.1	0.1	1.8%	1.8%
147 - 8	70	31.2	30.6	30.7	30.7	0.1	0.1	1.6%	1.6%
148 - 8	80	30.7	30.2	30.2	30.2	0.1	0.1	1.4%	1.4%
149 - 8	90	30.3	29.8	29.9	29.9	0.1	0.1	1.3%	1.3%
150 - 8	100	30.0	29.5	29.6	29.6	0.1	0.1	1.2%	1.2%
151 - 8	110	29.7	29.3	29.3	29.3	0.1	0.1	1.1%	1.1%
161 - 9	0	34.7	32.6	32.7	32.8	0.1	0.1	2.7%	2.8%
162 - 9	10	31.3	30.0	30.1	30.1	0.1	0.1	1.5%	1.6%
163 - 9	20	29.9	28.9	29.0	29.0	0.1	0.1	1.1%	1.1%
182 - 10	0	33.9	31.9	32.0	32.0	0.1	0.1	2.4%	2.5%
183 - 10	10	30.9	29.7	29.7	29.7	0.1	0.1	1.4%	1.4%
222 - 11	190	27.9	27.5	27.5	27.5	0.1	0.1	1.1%	1.1%
223 - 11	200	28.2	27.7	27.8	27.8	0.1	0.1	1.5%	1.7%
245 - 13	0	28.3	27.9	28.0	28.0	0.1	0.1	2.0%	2.2%

Receptor ID – Transect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
246 - 13	10	27.8	27.5	27.5	27.5	0.1	0.1	1.2%	1.3%
266 - 14	0	28.3	27.9	28.0	28.0	0.1	0.1	1.9%	2.0%
267 - 14	10	27.8	27.5	27.6	27.6	0.1	0.1	1.1%	1.1%
287 - 15	0	28.5	28.5	29.0	29.0	0.4	0.4	8.2%	8.3%
288 - 15	10	27.8	27.8	28.0	28.0	0.2	0.2	5.0%	5.0%
289 - 15	20	27.5	27.5	27.6	27.6	0.2	0.2	3.6%	3.6%
290 - 15	30	27.3	27.3	27.4	27.4	0.1	0.1	2.7%	2.8%
291 - 15	40	27.2	27.2	27.3	27.3	0.1	0.1	2.3%	2.3%
292 - 15	50	27.1	27.1	27.2	27.2	0.1	0.1	1.9%	1.9%
293 - 15	60	27.1	27.0	27.1	27.1	0.1	0.1	1.7%	1.7%
294 - 15	70	27.0	27.0	27.1	27.1	0.1	0.1	1.5%	1.5%
295 - 15	80	27.0	27.0	27.0	27.0	0.1	0.1	1.3%	1.3%
296 - 15	90	27.0	26.9	27.0	27.0	0.1	0.1	1.2%	1.2%
297 - 15	100	26.9	26.9	27.0	27.0	0.1	0.1	1.1%	1.1%
308 - 16	0	28.7	28.8	29.3	29.3	0.5	0.5	9.4%	9.4%
309 - 16	10	27.7	27.7	28.0	28.0	0.2	0.2	4.7%	4.7%
310 - 16	20	27.4	27.4	27.5	27.5	0.2	0.2	3.1%	3.1%
311 - 16	30	27.2	27.2	27.3	27.3	0.1	0.1	2.3%	2.3%
312 - 16	40	27.1	27.1	27.2	27.2	0.1	0.1	1.9%	1.9%
313 - 16	50	27.0	27.0	27.1	27.1	0.1	0.1	1.6%	1.6%

Receptor ID – Transect No.	Distance from designated site boundary (m)	N-Deposition (kgN/ha/yr)				Change in N-deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 1 2019 Base	Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 4 – Sc. 3*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 4 – Sc. 3*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
314 - 16	60	27.0	27.0	27.0	27.0	0.1	0.1	1.4%	1.4%
315 - 16	70	27.0	26.9	27.0	27.0	0.1	0.1	1.2%	1.2%
316 - 16	80	26.9	26.9	26.9	26.9	0.1	0.1	1.1%	1.1%
329 - 17	0	28.3	28.3	28.8	28.8	0.4	0.4	8.9%	9.0%
330 - 17	10	27.6	27.6	27.8	27.8	0.2	0.2	4.9%	4.9%
331 - 17	30	27.3	27.3	27.4	27.4	0.2	0.2	3.3%	3.3%
332 - 17	40	27.1	27.1	27.2	27.2	0.1	0.1	2.5%	2.5%
333 - 17	40	27.1	27.0	27.1	27.1	0.1	0.1	1.9%	2.0%
334 - 17	50	27.0	27.0	27.0	27.0	0.1	0.1	1.6%	1.6%
335 - 17	60	26.9	26.9	27.0	27.0	0.1	0.1	1.4%	1.4%
336 - 17	70	26.9	26.9	26.9	26.9	0.1	0.1	1.2%	1.2%
337 - 17	80	26.9	26.8	26.9	26.9	0.1	0.1	1.0%	1.0%
392 - 20	0	27.0	27.1	27.2	27.2	0.1	0.1	2.1%	2.1%
393 - 20	10	26.8	26.9	26.9	26.9	0.1	0.1	1.1%	1.1%
413 - 21	0	27.0	27.1	27.2	27.2	0.1	0.1	2.4%	2.3%
414 - 21	10	26.8	26.9	27.0	27.0	0.1	0.1	1.3%	1.3%

[1] – Without Calderdale Local Plan   [2] – With Calderdale Local Plan   [3] – Calderdale Local Plan + Emerging Bradford Plan   Note: All 2032 scenarios based on 2030 vehicle emissions factors

Note: Results calculated using max N-Deposition rate of 26.6 kgN/ha/yr

Table D-4 – Grid receptors within South Pennine Moors with a magnitude of change in annual mean NO_x concentrations of ≥1% of benchmark (2032)

Receptor ID	X, Y Grid Reference	Annual Mean NO_x (µg/m^3)			Change in Annual Mean NO_x (µg/m^3)		Magnitude of change as % of Benchmark (30 µg/m^3)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
60	396454, 417499	9.3	9.6	9.6	0.4	0.4	1.2%	1.2%
109	397066, 414452	22.1	22.4	22.4	0.3	0.3	1.0%	1.0%
184	397475, 418108	8.8	9.2	9.2	0.4	0.4	1.2%	1.2%
204	397679, 414656	25.1	25.5	25.5	0.4	0.4	1.2%	1.2%
221	397679, 418108	9.7	10.4	10.4	0.7	0.7	2.2%	2.3%
261	397883, 418108	9.5	10.2	10.2	0.6	0.6	2.1%	2.1%
378	398496, 414452	22.9	23.3	23.3	0.3	0.3	1.1%	1.1%
397	398496, 418311	9.3	10.0	10.0	0.6	0.6	2.1%	2.1%
427	398700, 414656	31.2	31.8	31.8	0.6	0.6	1.9%	1.9%
476	398904, 415062	12.8	13.2	13.2	0.4	0.4	1.4%	1.4%
527	399108, 415062	14.0	14.4	14.4	0.4	0.4	1.3%	1.3%
581	399313, 415265	12.2	12.7	12.7	0.5	0.5	1.7%	1.7%
636	399517, 415265	12.7	13.3	13.3	0.6	0.6	1.9%	2.0%
691	399721, 415468	11.9	12.6	12.6	0.7	0.7	2.3%	2.3%
740	399925, 415468	12.0	12.6	12.6	0.6	0.6	1.9%	1.9%
786	400130, 415671	13.6	14.2	14.2	0.6	0.6	2.0%	2.1%
827	400334, 415874	13.3	14.0	14.0	0.7	0.7	2.3%	2.3%
865	400538, 415874	13.4	14.0	14.0	0.6	0.6	2.1%	2.1%

Receptor ID	X, Y Grid Reference	Annual Mean NO_x ($\mu g/m^3$)			Change in Annual Mean NO_x ($\mu g/m^3$)		Magnitude of change as % of Benchmark (30 $\mu g/m^3$)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
904	400742, 416077	9.9	10.4	10.4	0.5	0.5	1.7%	1.7%
931	400946, 413640	19.9	20.2	20.2	0.3	0.3	1.1%	1.1%
943	400946, 416077	10.4	11.2	11.2	0.8	0.8	2.6%	2.6%
979	401151, 416077	10.8	11.4	11.4	0.6	0.7	2.2%	2.2%
1015	401355, 416077	12.2	13.6	13.6	1.4	1.4	4.7%	4.7%
1035	401559, 413640	22.8	23.2	23.2	0.4	0.4	1.4%	1.4%
1047	401559, 416077	16.3	20.1	20.1	3.8	3.8	12.6%	12.7%
1068	401763, 413640	32.1	32.6	32.6	0.5	0.5	1.6%	1.6%
1080	401763, 416077	11.7	12.3	12.3	0.6	0.6	2.0%	2.0%
1279	390647, 428475	7.5	7.9	7.9	0.4	0.4	1.4%	1.4%

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan Note: All 2032 scenarios based on 2030 vehicle emissions factors

Table D-5 – Grid receptors within South Pennine Moors with a magnitude of change in annual mean NH_3 concentrations of ≥1% of benchmark (2032)

Receptor ID	X, Y Grid Reference	Annual Mean NH_3 (μg/m^3)			Change in Annual Mean NH_3 (μg/m^3)		Magnitude of change as % of Benchmark (1 μg/m^3)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
58	396454, 417093	1.58	1.59	1.59	0.0	0.0	1.1%	1.2%
59	396454, 417296	1.57	1.58	1.58	0.0	0.0	1.0%	1.0%
60	396454, 417499	1.64	1.67	1.67	0.0	0.0	2.6%	2.6%
109	397066, 414452	2.20	2.22	2.22	0.0	0.0	1.2%	1.2%
126	397066, 417905	1.57	1.58	1.58	0.0	0.0	1.0%	1.1%
152	397270, 418108	1.59	1.61	1.61	0.0	0.0	1.5%	1.5%
184	397475, 418108	1.65	1.67	1.67	0.0	0.0	2.6%	2.6%
204	397679, 414656	2.48	2.50	2.50	0.0	0.0	1.5%	1.5%
221	397679, 418108	1.73	1.78	1.79	0.1	0.1	5.3%	5.4%
261	397883, 418108	1.71	1.76	1.76	0.0	0.0	4.9%	4.9%
305	398087, 418108	1.58	1.59	1.59	0.0	0.0	1.3%	1.3%
378	398496, 414452	2.57	2.59	2.59	0.0	0.0	2.2%	2.2%
380	398496, 414859	2.14	2.15	2.15	0.0	0.0	1.2%	1.2%
397	398496, 418311	1.72	1.77	1.77	0.0	0.1	5.0%	5.0%
427	398700, 414656	3.16	3.19	3.19	0.0	0.0	3.2%	3.2%
444	398700, 418311	1.57	1.58	1.58	0.0	0.0	1.1%	1.1%
476	398904, 415062	1.78	1.81	1.81	0.0	0.0	2.4%	2.4%
527	399108, 415062	1.82	1.84	1.84	0.0	0.0	2.1%	2.2%

Receptor ID	X, Y Grid Reference	Annual Mean NH_3 (µg/m^3)			Change in Annual Mean NH_3 (µg/m^3)		Magnitude of change as % of Benchmark (1 µg/m^3)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
528	399108, 415265	1.66	1.67	1.67	0.0	0.0	1.1%	1.1%
581	399313, 415265	1.71	1.74	1.74	0.0	0.0	3.0%	3.0%
636	399517, 415265	1.74	1.77	1.77	0.0	0.0	3.4%	3.4%
637	399517, 415468	1.63	1.64	1.64	0.0	0.0	1.0%	1.0%
691	399721, 415468	1.70	1.74	1.74	0.0	0.0	4.2%	4.2%
706	399721, 418515	1.60	1.62	1.62	0.0	0.0	2.0%	2.0%
740	399925, 415468	1.70	1.73	1.73	0.0	0.0	3.2%	3.2%
785	400130, 415468	1.69	1.70	1.70	0.0	0.0	1.0%	1.0%
786	400130, 415671	1.67	1.71	1.71	0.0	0.0	3.6%	3.7%
813	400334, 412828	2.15	2.16	2.16	0.0	0.0	1.4%	1.4%
826	400334, 415671	1.65	1.66	1.66	0.0	0.0	1.5%	1.5%
827	400334, 415874	1.66	1.70	1.70	0.0	0.0	4.2%	4.2%
865	400538, 415874	1.66	1.69	1.69	0.0	0.0	3.6%	3.6%
903	400742, 415874	1.63	1.64	1.64	0.0	0.0	1.2%	1.2%
904	400742, 416077	1.63	1.66	1.66	0.0	0.0	2.9%	3.0%
931	400946, 413640	2.52	2.54	2.54	0.0	0.0	2.2%	2.3%
943	400946, 416077	1.67	1.72	1.72	0.0	0.0	4.6%	4.7%
979	401151, 416077	1.66	1.70	1.70	0.0	0.0	3.7%	3.8%
1015	401355, 416077	1.78	1.88	1.88	0.1	0.1	9.6%	9.7%
1035	401559, 413640	2.80	2.83	2.83	0.0	0.0	2.8%	2.9%

Receptor ID	X, Y Grid Reference	Annual Mean NH_3 (µg/m^3)			Change in Annual Mean NH_3 (µg/m^3)		Magnitude of change as % of Benchmark (1 µg/m^3)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
1047	401559, 416077	2.14	2.43	2.43	0.3	0.3	28.8%	29.0%
1068	401763, 413640	3.71	3.75	3.75	0.0	0.0	3.7%	3.7%
1080	401763, 416077	1.72	1.75	1.75	0.0	0.0	3.3%	3.3%
1188	402785, 415062	1.76	1.78	1.78	0.0	0.0	1.9%	2.0%
1223	403397, 415468	1.77	1.78	1.79	0.0	0.0	1.9%	2.0%
1271	390036, 428475	1.61	1.64	1.63	0.0	0.0	2.1%	2.1%
1279	390647, 428475	1.69	1.73	1.73	0.0	0.0	3.8%	3.8%

[1] – Without Calderdale Local Plan [2] – With Calderdale Local Plan [3] – Calderdale Local Plan + Emerging Bradford Plan Note: All 2032 scenarios based on 2030 vehicle emissions factors

Note: All 2032 scenarios based on 2030 vehicle emissions factors and APIS Annual Mean NH_3 background (1.5 µg/m^3)

Table D-6 – Grid receptors within South Pennine Moors with a magnitude of change in N-Deposition concentrations of ≥1% of benchmark (2032)

Receptor ID	X, Y Grid Reference	N-Deposition (kgN/ha/yr)			Change in N-Deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
58	396454, 417093	27.0	27.1	27.1	0.1	0.1	1.5%	1.5%
59	396454, 417296	26.9	27.0	27.0	0.1	0.1	1.3%	1.3%
60	396454, 417499	27.4	27.5	27.5	0.2	0.2	3.2%	3.2%
109	397066, 414452	31.0	31.1	31.1	0.1	0.1	1.7%	1.7%
126	397066, 417905	27.0	27.0	27.0	0.1	0.1	1.4%	1.4%
152	397270, 418108	27.1	27.2	27.2	0.1	0.1	1.9%	1.9%
184	397475, 418108	27.4	27.6	27.6	0.2	0.2	3.3%	3.3%
204	397679, 414656	32.6	32.7	32.7	0.1	0.1	2.1%	2.1%
221	397679, 418108	27.9	28.2	28.2	0.3	0.3	6.5%	6.6%
244	397883, 414656	30.3	30.4	30.4	0.1	0.1	1.4%	1.4%
245	397883, 414859	29.5	29.5	29.5	0.1	0.1	1.2%	1.2%
261	397883, 418108	27.8	28.1	28.1	0.3	0.3	6.0%	6.1%
288	398087, 414656	30.0	30.1	30.1	0.1	0.1	1.3%	1.3%
289	398087, 414859	29.8	29.8	29.8	0.1	0.1	1.3%	1.3%
305	398087, 418108	27.0	27.1	27.1	0.1	0.1	1.7%	1.7%
333	398292, 414656	29.8	29.8	29.8	0.1	0.1	1.2%	1.2%
334	398292, 414859	30.0	30.1	30.1	0.1	0.1	1.4%	1.4%
378	398496, 414452	32.9	33.1	33.1	0.1	0.1	2.7%	2.7%

Receptor ID	X, Y Grid Reference	N-Deposition (kgN/ha/yr)			Change in N-Deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone *(Sc. 3 – Sc. 2)*	Impact of Local Plan In-combination *(Sc. 4 – Sc. 2)*	Local Plan Alone *(Sc. 3 – Sc. 2)*	Local Plan In-combination *(Sc. 4 – Sc. 2)*
379	398496, 414656	29.6	29.6	29.6	0.1	0.1	1.1%	1.1%
380	398496, 414859	30.6	30.7	30.7	0.1	0.1	1.7%	1.7%
397	398496, 418311	27.8	28.1	28.1	0.3	0.3	6.1%	6.2%
427	398700, 414656	36.6	36.8	36.8	0.2	0.2	4.1%	4.2%
444	398700, 418311	26.9	27.0	27.0	0.1	0.1	1.4%	1.4%
476	398904, 415062	28.3	28.5	28.5	0.2	0.2	3.1%	3.1%
493	398904, 418515	26.9	26.9	26.9	0.1	0.1	1.1%	1.1%
527	399108, 415062	28.6	28.7	28.7	0.1	0.1	2.8%	2.8%
528	399108, 415265	27.5	27.6	27.6	0.1	0.1	1.5%	1.5%
544	399108, 418515	26.9	26.9	26.9	0.1	0.1	1.2%	1.2%
580	399313, 415062	28.8	28.9	28.9	0.1	0.1	1.3%	1.3%
581	399313, 415265	27.8	28.0	28.0	0.2	0.2	3.9%	3.9%
597	399313, 418515	26.9	26.9	26.9	0.1	0.1	1.1%	1.1%
636	399517, 415265	28.0	28.3	28.3	0.2	0.2	4.4%	4.4%
637	399517, 415468	27.4	27.4	27.4	0.1	0.1	1.4%	1.4%
652	399517, 418515	26.9	27.0	27.0	0.1	0.1	1.3%	1.3%
689	399721, 415062	32.4	32.4	32.4	0.1	0.1	1.0%	1.1%
690	399721, 415265	28.0	28.1	28.1	0.1	0.1	1.3%	1.3%
691	399721, 415468	27.8	28.0	28.1	0.3	0.3	5.4%	5.4%
706	399721, 418515	27.1	27.3	27.3	0.1	0.1	2.5%	2.5%

Receptor ID	X, Y Grid Reference	N-Deposition (kgN/ha/yr)			Change in N-Deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
740	399925, 415468	27.8	28.0	28.0	0.2	0.2	4.2%	4.2%
741	399925, 415671	27.3	27.3	27.3	0.1	0.1	1.3%	1.3%
755	399925, 418515	26.9	26.9	26.9	0.1	0.1	1.1%	1.1%
785	400130, 415468	27.7	27.8	27.8	0.1	0.1	1.4%	1.4%
786	400130, 415671	27.6	27.8	27.8	0.2	0.2	4.7%	4.7%
812	400334, 412625	29.0	29.1	29.1	0.1	0.1	1.1%	1.1%
813	400334, 412828	30.5	30.6	30.6	0.1	0.1	1.7%	1.8%
826	400334, 415671	27.5	27.6	27.6	0.1	0.1	2.0%	2.0%
827	400334, 415874	27.5	27.8	27.8	0.3	0.3	5.4%	5.4%
854	400538, 413437	28.8	28.8	28.8	0.1	0.1	1.0%	1.0%
865	400538, 415874	27.5	27.8	27.8	0.2	0.2	4.6%	4.7%
866	400538, 416077	27.1	27.2	27.2	0.1	0.1	1.2%	1.2%
903	400742, 415874	27.3	27.4	27.4	0.1	0.1	1.6%	1.6%
904	400742, 416077	27.4	27.5	27.5	0.2	0.2	3.8%	3.9%
931	400946, 413640	32.7	32.9	32.9	0.1	0.1	2.7%	2.8%
943	400946, 416077	27.6	27.9	27.9	0.3	0.3	6.0%	6.0%
979	401151, 416077	27.6	27.8	27.8	0.2	0.2	4.9%	4.9%
980	401151, 416280	27.1	27.1	27.1	0.1	0.1	1.1%	1.1%
1015	401355, 416077	28.3	28.9	28.9	0.6	0.6	12.1%	12.2%
1016	401355, 416280	27.1	27.2	27.2	0.1	0.1	1.1%	1.1%

Receptor ID	X, Y Grid Reference	N-Deposition (kgN/ha/yr)			Change in N-Deposition (kgN/ha/yr)		Magnitude of change as % of Benchmark (5 kgN/ha/yr)	
		Sc. 2 2032 Future Base[1]	Sc. 3 2032 With Local Plan Only[2]	Sc. 4 2032 With Local Plan +Bradford[2,3]	Impact of Local Plan Alone (*Sc. 3 – Sc. 2*)	Impact of Local Plan In-combination (*Sc. 4 – Sc. 2*)	Local Plan Alone (*Sc. 3 – Sc. 2*)	Local Plan In-combination (*Sc. 4 – Sc. 2*)
1035	401559, 413640	34.4	34.6	34.6	0.2	0.2	3.5%	3.6%
1045	401559, 415671	35.4	35.5	35.5	0.1	0.1	1.0%	1.1%
1047	401559, 416077	30.5	32.2	32.2	1.8	1.8	35.4%	35.7%
1048	401559, 416280	27.2	27.2	27.2	0.1	0.1	1.1%	1.1%
1068	401763, 413640	39.8	40.0	40.0	0.2	0.2	4.5%	4.6%
1080	401763, 416077	27.9	28.1	28.1	0.2	0.2	4.3%	4.4%
1081	401763, 416280	27.3	27.3	27.3	0.1	0.1	1.3%	1.3%
1156	402376, 414452	27.3	27.4	27.4	0.0	0.1	1.0%	1.0%
1188	402785, 415062	28.1	28.2	28.2	0.1	0.1	2.3%	2.5%
1223	403397, 415468	28.1	28.3	28.3	0.1	0.1	2.3%	2.5%
1271	390036, 428475	27.2	27.3	27.3	0.1	0.1	2.5%	2.5%
1279	390647, 428475	27.6	27.9	27.9	0.2	0.2	4.6%	4.6%

1 – Without Calderdale Local Plan 2 – With Calderdale Local Plan 3 – Calderdale Local Plan + Emerging Bradford Plan Note: All 2032 scenarios based on 2030 vehicle emissions factors

Note: Results calculated using max N-Deposition rate of 26.6 kgN/ha/yr

8 First Street
Manchester
M15 4RP

wsp.com