Air Quality CONSULTANTS

# Air Quality Assessment:

## New Forest District Council Local Plan Impacts

March 2018

Experts in air quality management & assessment

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# 1 Introduction

1.1 This report describes the potential air quality impacts on relevant receptors, in relation to the human health objectives, associated with the proposed New Forest District Council Local Plan.

1.2 The air quality assessment focuses on two future years; 2026 and 2036, following the proposed Local Plan land allocations. The quantum of Local Plan development for Local Plan development for 2026 is determined based on the trajectory supplied by the New Forest District Council, with 2036 completing the plan period, and thus containing all planned land allocations. The approximate total supply of housing delivered during the plan period is 10,500-13,000 units, with an estimated 60-65% delivered by 2026.

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

# 2 Policy Context and Assessment Criteria

## Air Quality Strategy

2.1 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

## Planning Policy

### *National Policies*

2.2 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for England in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should *"contribute to…reducing pollution"*. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location. The NPPF states that the *"effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account"*.

2.3 More specifically the NPPF makes clear that:

*"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan".*

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2017), which includes guiding principles on how planning can take account of the impacts of new development on air

quality. The PPG states that *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit".* The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*".

2.5 The PPG states that:

*"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU".*

2.6 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

### *Local Policies*

2.7 The Core Strategy for the New Forest District outside of the National Park (New Forest District Council, 2009) was adopted in October 2009, and within this is one policy which refers to air quality. Policy CS5 Safe and healthy communities states that:

*"Development should not result in pollution or hazards which prejudice the health and safety of communities and their environments…*

*…When the opportunity arises, particularly through development proposals, remedial measures will be taken to address existing problems of land contamination or air quality".*

2.8 The New Forest National Park Core Strategy and Development Management Policies (New Forest National Park, 2010) was adopted in December 2010. Policy CP6 Pollution relates to air quality and states:

*"Opportunities should be taken to control and reduce the impacts of noise, visual intrusion, nuisance and other unacceptable environmental impacts on the National Park and its special qualities."*

## Air Quality Action Plans

### *National Air Quality Plan*

2.9 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017a). Alongside a package of national measures, the Plan requires those Local Authorities that are predicted to have exceedances of the limit values beyond 2020 to produce local action plans by March 2018. These plans must have measures to achieve the statutory limit values within the shortest possible time. There is currently no practical way to take account of the effects of the national Plan in the modelling undertaken for this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the Air Quality Plan.

### *Local Air Quality Action Plan*

2.10 New Forest District Council declared an Air Quality Management Area in 2005 for exceedances of the annual mean nitrogen dioxide objective within Lyndhurst. The Council has since developed an Air Quality Action Plan (New Forest Distict Council, 2008). This focuses on a series of measures to reduce road traffic emissions including reducing heavy duty vehicles emissions within Lyndhurst, it also focuses on reducing congestion through traffic management.

## Assessment Criteria

2.11 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002).

2.12 The objectives for nitrogen dioxide and $PM_{10}$ were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2016). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour $PM_{10}$ objective could be exceeded at roadside locations where the annual mean

concentration is above 32 µg/m$^3$ (Defra, 2016). The predicted annual mean $PM_{10}$ concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean $PM_{10}$ objective. Where predicted annual mean concentrations are below 32 µg/m$^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.13 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2016). The annual mean objectives for nitrogen dioxide and $PM_{10}$ are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for $PM_{10}$ is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.14 The European Union has also set limit values for nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ (The European Parliament and the Council of the European Union, 2008). The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

2.15 The relevant air quality criteria for this assessment are provided in Table 1.

**Table 1: Air Quality Criteria for Nitrogen Dioxide, $PM_{10}$ and $PM_{2.5}$**

| Pollutant | Time Period | Objective |
|---|---|---|
| **Nitrogen Dioxide** | 1-hour Mean | 200 µg/m$^3$ not to be exceeded more than 18 times a year |
| | Annual Mean | 40 µg/m$^3$ |
| **Fine Particles ($PM_{10}$)** | 24-hour Mean | 50 µg/m$^3$ not to be exceeded more than 35 times a year |
| | Annual Mean | 40 µg/m$^3$ [a] |
| **Fine Particles ($PM_{2.5}$)** [b] | Annual Mean | 25 µg/m$^3$ |

[a] A proxy value of 32 µg/m$^3$ as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean $PM_{10}$ objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean $PM_{10}$ objective are possible (Defra, 2016).

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

### *Descriptors for Air Quality Impacts and Assessment of Significance*

2.16 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (Moorcroft and Barrowcliffe et al, 2017). This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A1.

[1] The IAQM is the professional body for air quality practitioners in the UK.

# 3 Assessment Approach

## Existing Conditions

3.1 Background concentrations across the study area have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid. 2015 has been used as the base year, with 2026 and 2036 as future years. Since the background maps only predict up to 2030, the values for 2030 have been used for 2036.

## Road Traffic Impacts

### *Sensitive Locations*

3.2 Concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ have been predicted at a number of relevant receptor locations within the New Forest District Council boundary. When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested and where there is a combined effect of several road links, and close to those roads where the traffic increases as a result of the Local Plan will be greatest.

3.3 A total of 433 existing residential properties have been identified as receptors for the assessment. These locations are shown in Figure 1. In addition, concentrations have been modelled at the diffusion tube monitoring sites located within Lyndhurst, as well as at Site 31 (adjacent to the A31), Site 34 (adjacent to Normandy Way) and Site 36 (adjacent to Marchwood By-pass) in order to verify the model outputs (see Appendix A3 for verification method).

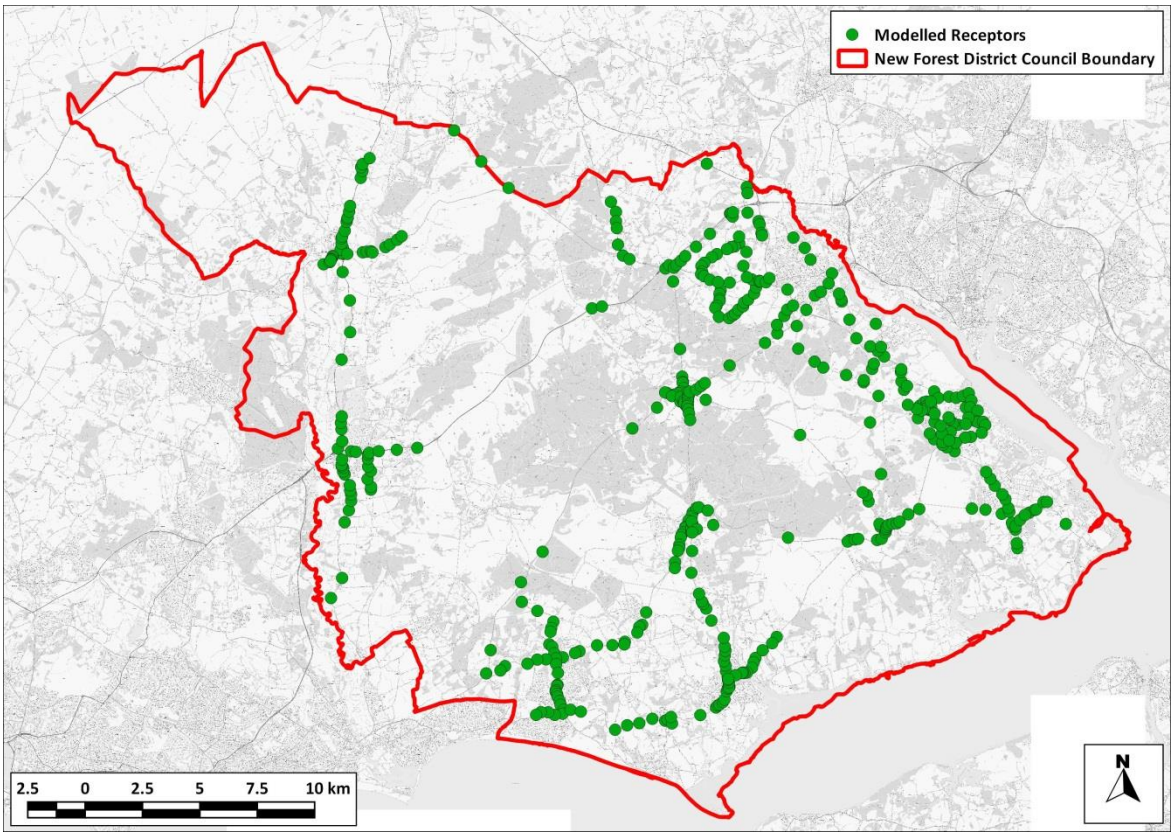


**Figure 1: Modelled Receptor Locations**

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### *Assessment Scenarios*

3.4 Nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ concentrations have been predicted for a base year (2015) and two future year scenarios; 2026 and 2036. For 2026 and 2036, predictions have been made assuming both that the Local Plan does proceed (With-Local Plan), and does not proceed (Without-Local Plan). In addition to the set of 'official' predictions, a sensitivity test has been carried out for nitrogen dioxide that involves assuming much higher nitrogen oxides emissions from certain vehicles than have been predicted by Defra, using AQC's Calculator Using Realistic Emissions for Diesels (CURED V2A) tool (AQC, 2016a). This is to address the potential under-performance of emissions control technology on modern diesel vehicles (AQC, 2016b)[2].

[2] Since the modelling was carried out Defra has issued a new version of the EFT, (version 8). AQC has carried out some initial testing that indicates that EFT v8 produces similar results to those of the CURED v2A model, especially in 2026, while in 2036 the CURED model produces higher concentrations. On this basis it is not considered necessary to re-model using EFT v8. Where reference is made to "the official" emission factors then this is to the EFT v7 factors.

### Modelling Methodology

3.5 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in Appendix A3, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

### Traffic Data

3.6 Traffic data for the assessment have been provided by Systra, who have undertaken the transport assessment for the Local Plan proposals in the New Forest. Further details of the traffic data used in this assessment are provided in Appendix A3.

### Uncertainty in Road Traffic Modelling Predictions

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

3.8 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2015) concentrations.

3.9 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

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

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

3.12 A detailed analysis of emissions from modern diesel vehicles has been carried out (AQC, 2016b). This shows that, where previous standards had limited on-road success, the 'Euro VI' and 'Euro 6' standards that new vehicles have had to comply with from 2013/16[3] are delivering real on-road improvements. A detailed comparison of the predictions in Defra's latest Emission Factor Toolkit (EFT) v7.0 against the results from on-road emissions tests has shown that Defra's latest predictions still have the potential to under-predict emissions from some vehicles, albeit by less than has historically been the case (AQC, 2016b)[4]. In order to account for this potential under-prediction, a sensitivity test has been carried out in which the emissions from Euro IV, Euro V, Euro VI, and Euro 6 vehicles have been uplifted as described in Paragraph A3.5 in Appendix A3, using AQC's CURED (V2A) tool (AQC, 2016a). The results from this sensitivity test are likely to over-predict emissions from vehicles in the future (AQC, 2016b) and thus provide a reasonable worst-case upper-bound to the assessment.

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

[4] See update in Footnote 7.

# 4 Baseline Conditions

## Background Concentrations

4.1 Estimated background concentrations in the study area have been determined for 2015 and the future years of 2026 and 2036 using Defra's background maps (Defra, 2017c). The background concentrations are set out in Table 2 and have been derived as described in Appendix A3. The background concentrations are all well below the objectives.

**Table 2: Estimated Annual Mean Background Pollutant Concentrations in 2015, 2026 and 2036 (µg/m$^3$)**

| Year | $NO_2$ | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|
| **2015** | 7.4 – 20.6 | 12.3 – 15.8 | 8.8 – 11.2 |
| **2026** [a] | 5.2 – 18.4 | 11.5 – 15.0 | 8.2 – 10.4 |
| ***2026 Worst-case Sensitivity Test*** [b] | *5.4 – 19.0* | *N/A* | *N/A* |
| **2036** [a] | 4.8 – 18.2 | 11.3 – 14.9 | 8.0 – 10.3 |
| ***2036 Worst-case Sensitivity Test*** [b] | *5.1 – 18.8* | *N/A* | *N/A* |
| **Objectives** | **40** | **40** | **25** [c] |

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Appendix A3.

[c] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

## Baseline Dispersion Model Results

4.2 Baseline concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ have been modelled at each of the receptor locations (see Figure 1 for receptor locations). The results, which cover both the existing (2015) and future years (2026 and 2036) baseline (Without Local-Plan), are shown in Figure 2 to Figure 13. The predictions for nitrogen dioxide include a sensitivity test which accounts for the potential under-performance of emissions control technology on modern diesel vehicles. In addition, the modelled road components of nitrogen oxides, $PM_{10}$ and $PM_{2.5}$ have been increased from those predicted by the model based on a comparison with local measurements (see Appendix A3 for the verification methodology).

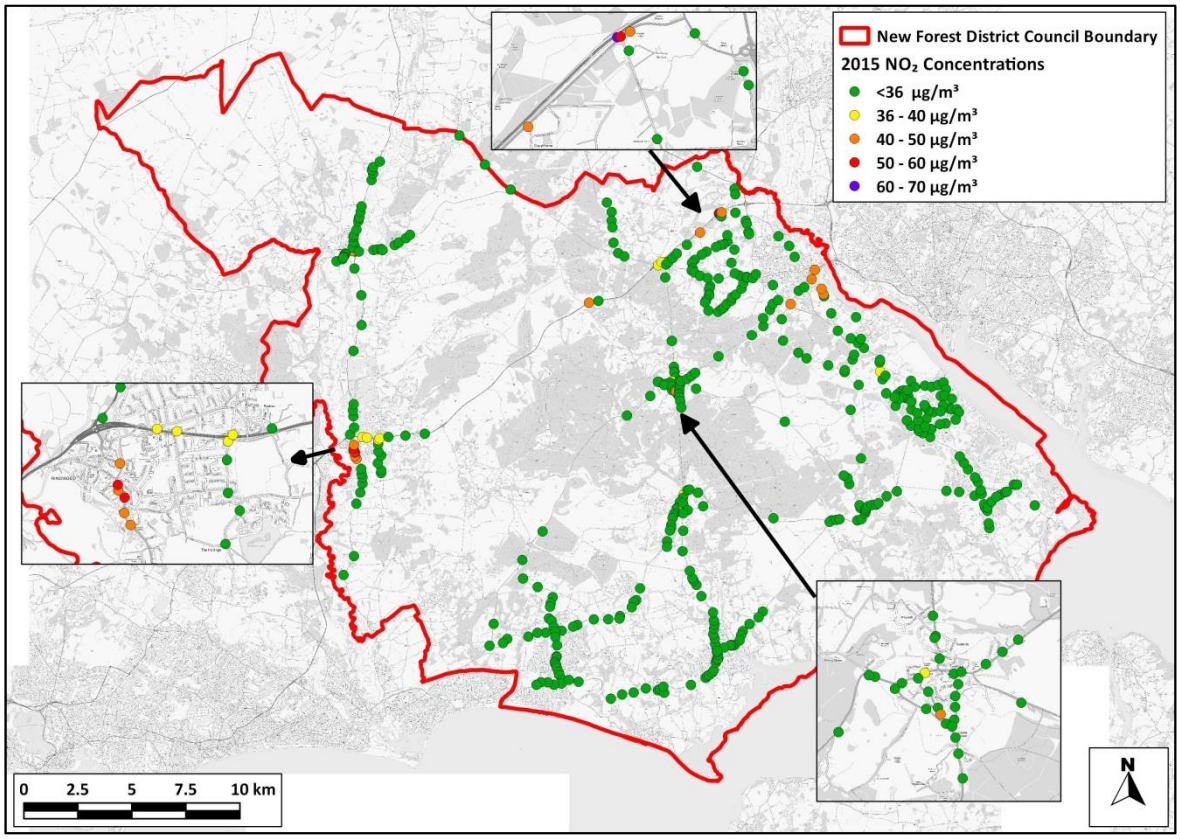


**Figure 2: 2015 Nitrogen Dioxide Concentrations (µg/m$^3$)**

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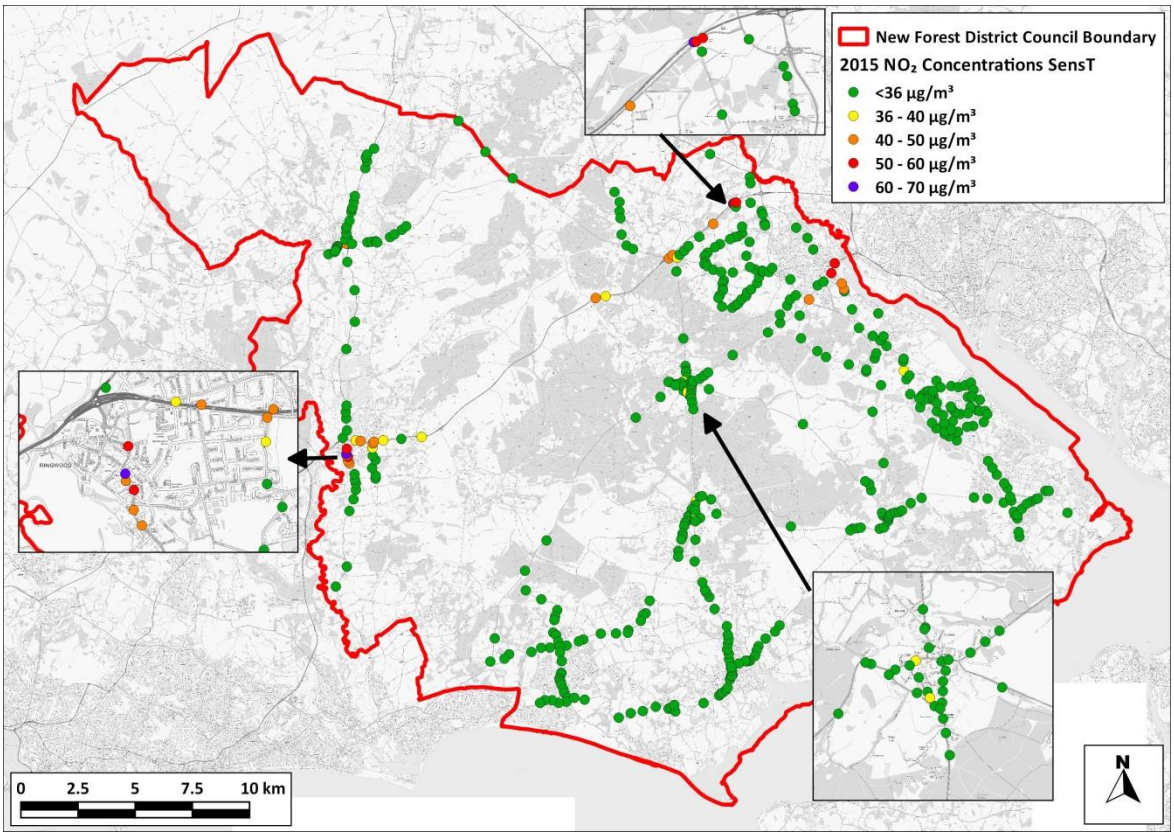


**Figure 3: 2015 Nitrogen Dioxide Concentrations (µg/m$^3$) Sensitivity Test**

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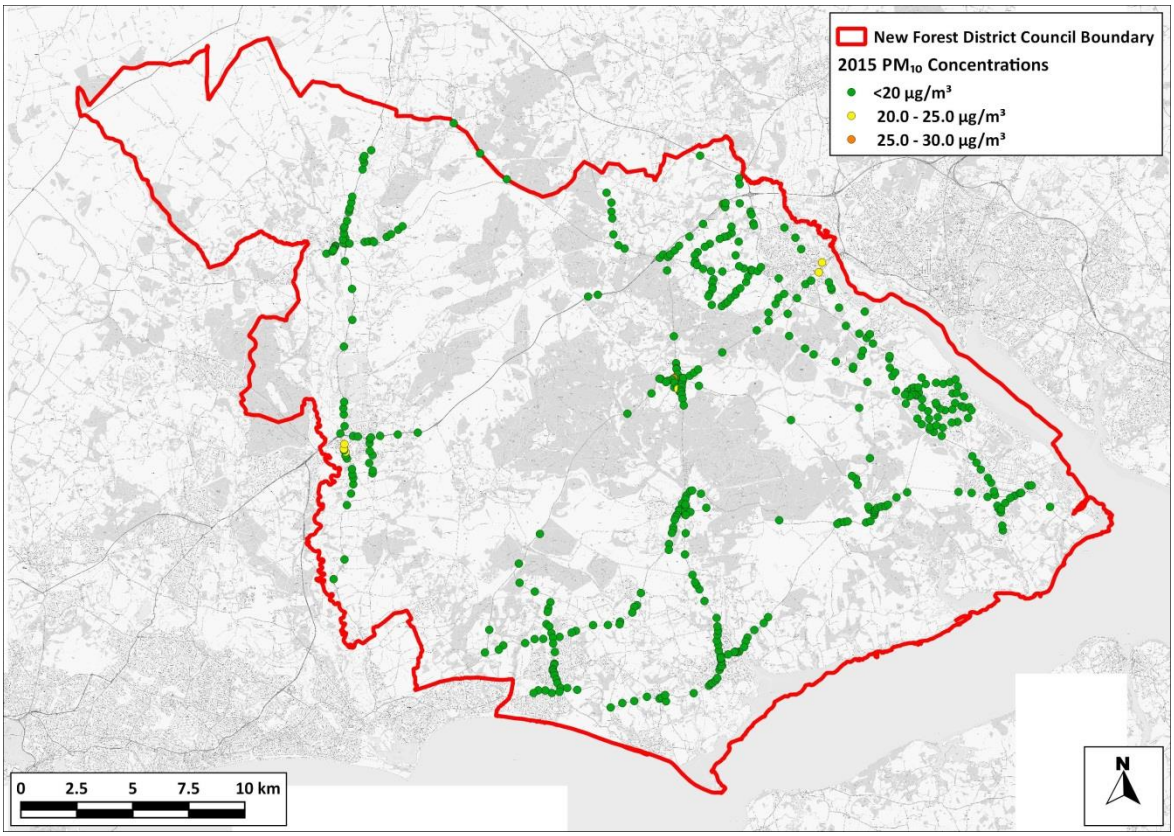


**Figure 4: 2015 $PM_{10}$ Concentrations (µg/m$^3$)**

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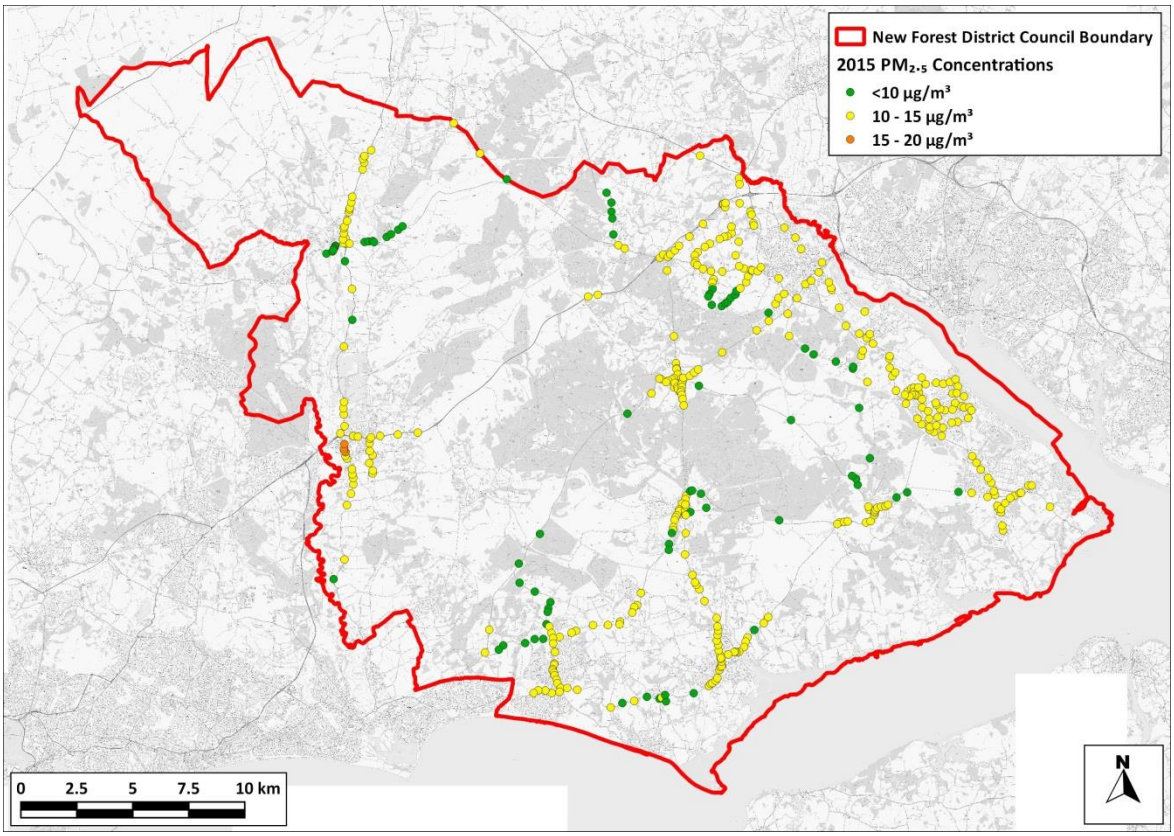


**Figure 5: 2015 $PM_{2.5}$ Concentrations (µg/m$^3$)**

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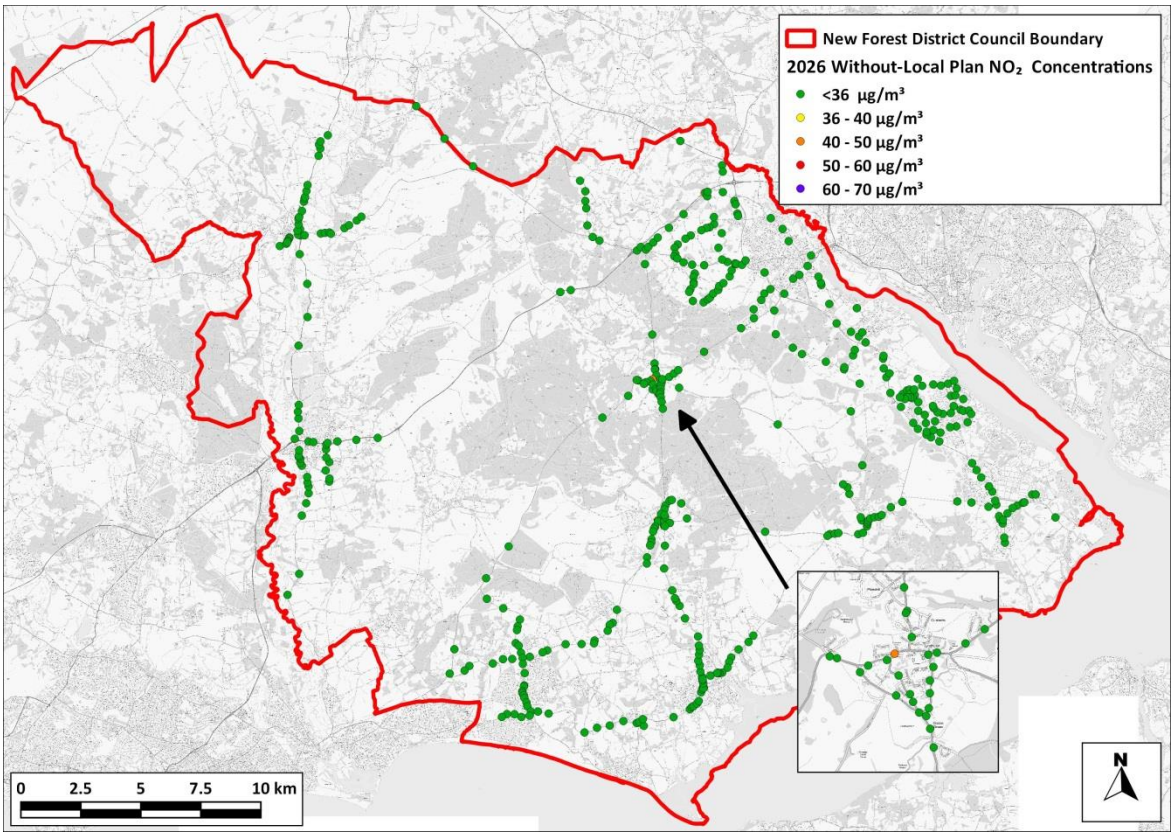


**Figure 6: 2026 Without-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$)**

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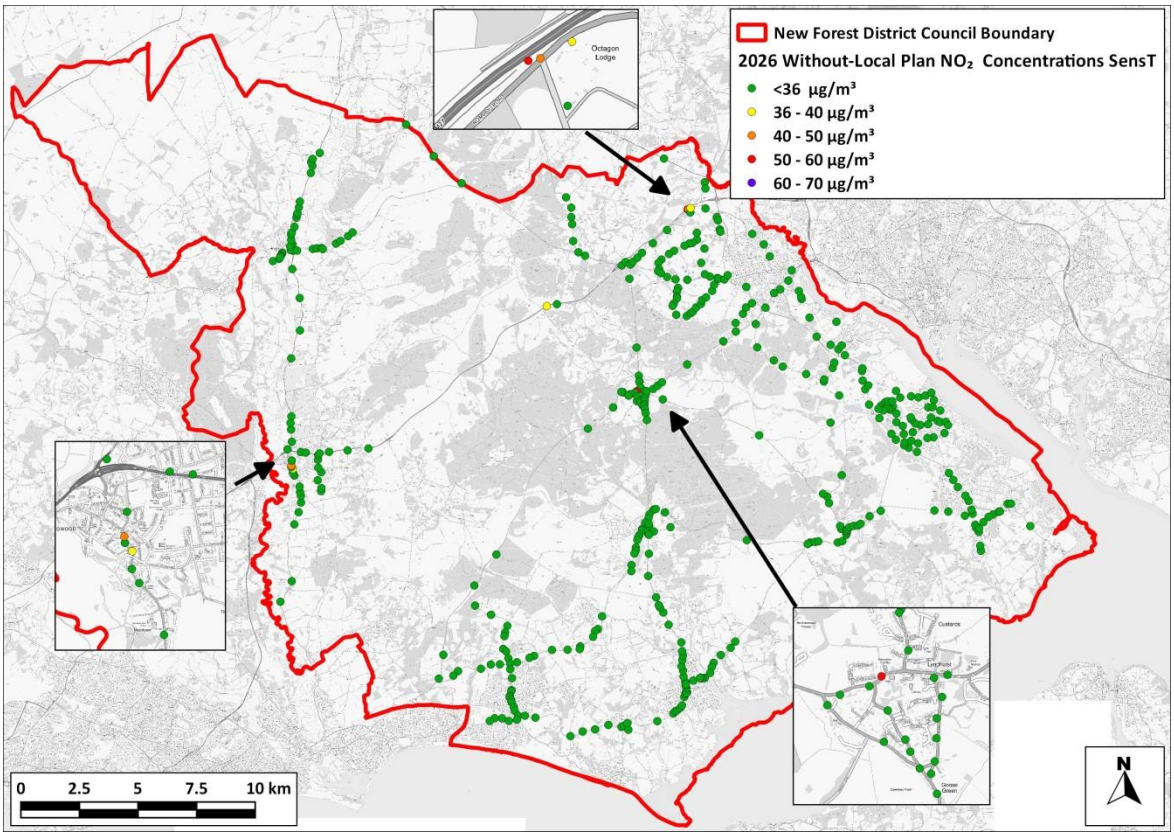


**Figure 7: 2026 Without-Local Plan Nitrogen Dioxide Concentrations Sensitivity Test (µg/m$^3$)**

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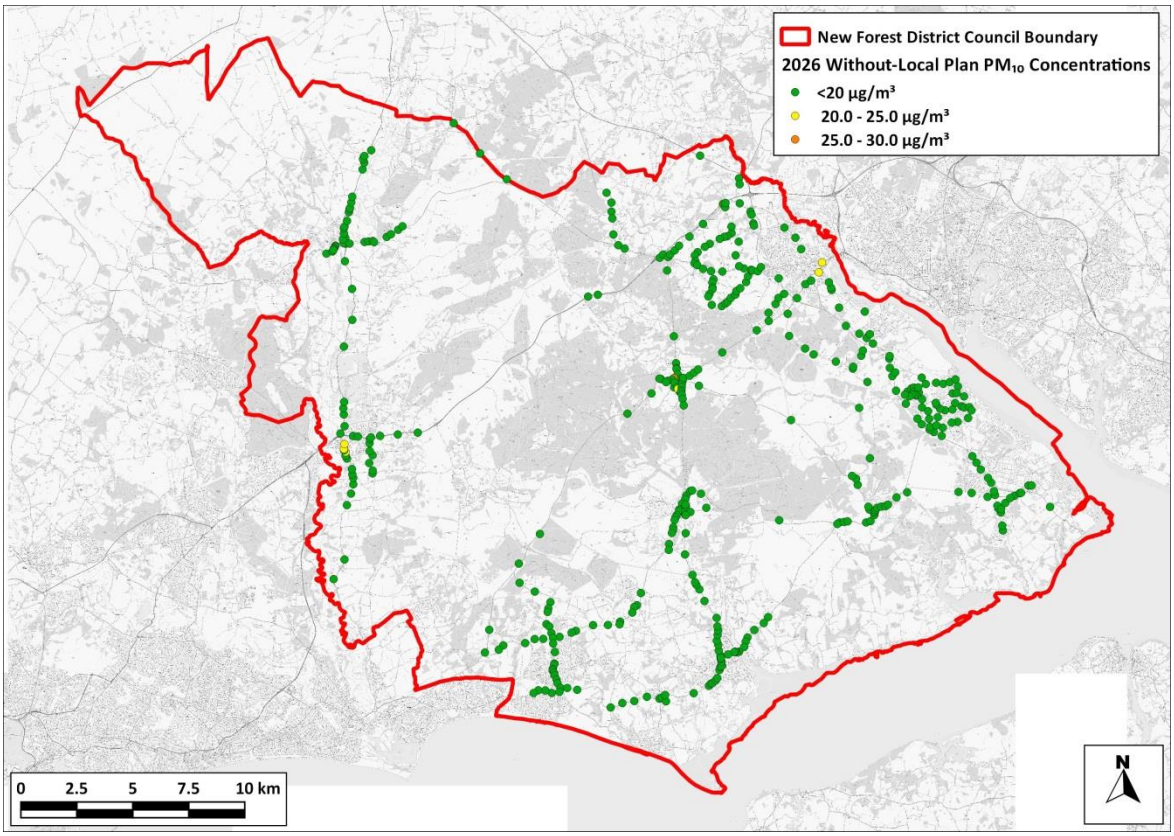


**Figure 8: 2026 Without-Local Plan $PM_{10}$ Concentrations (µg/m$^3$)**

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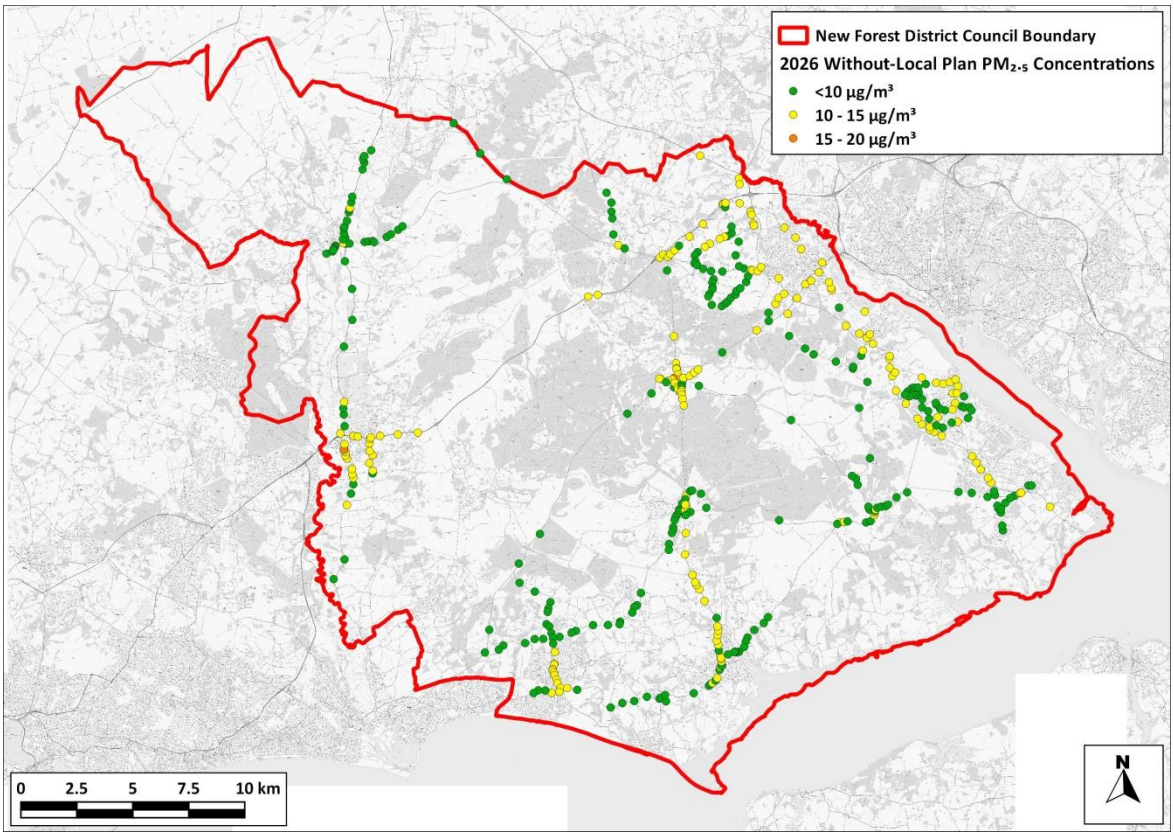


**Figure 9: 2026 Without-Local Plan $PM_{2.5}$ Concentrations ($\mu g/m^3$)**

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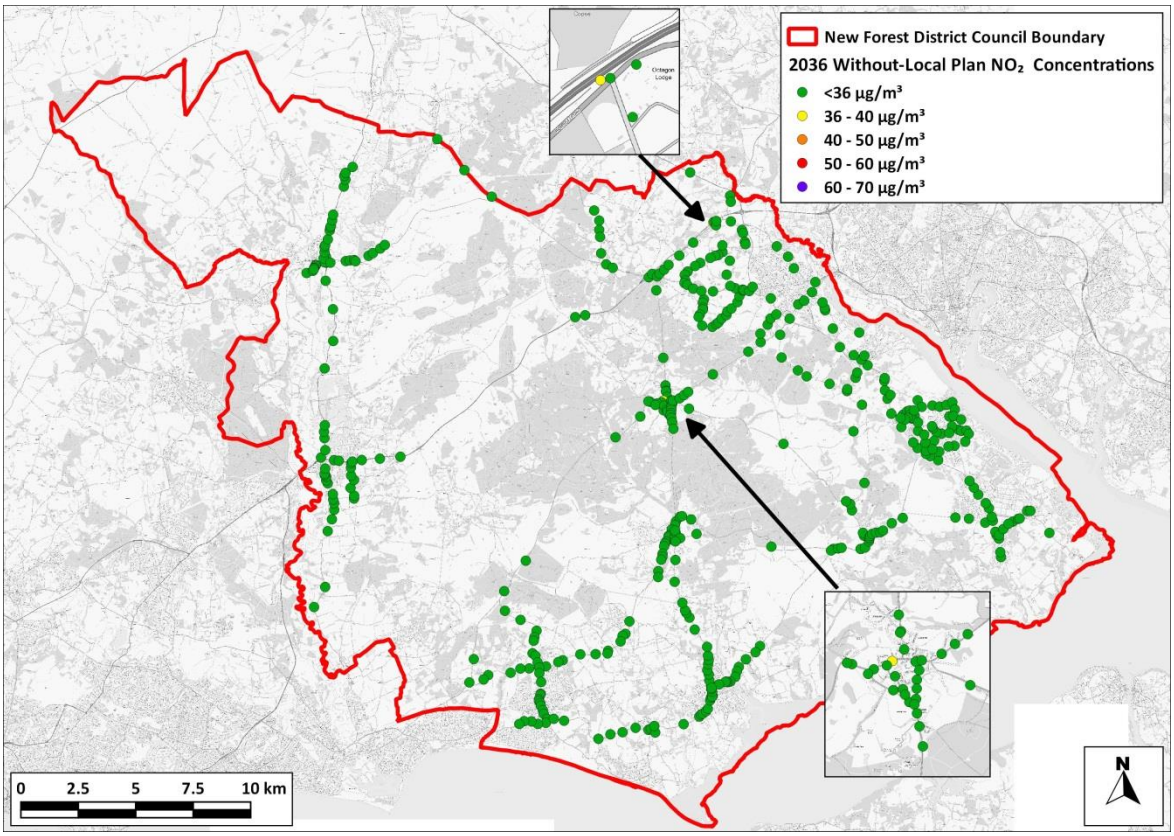


**Figure 10: 2036 Without-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$)**

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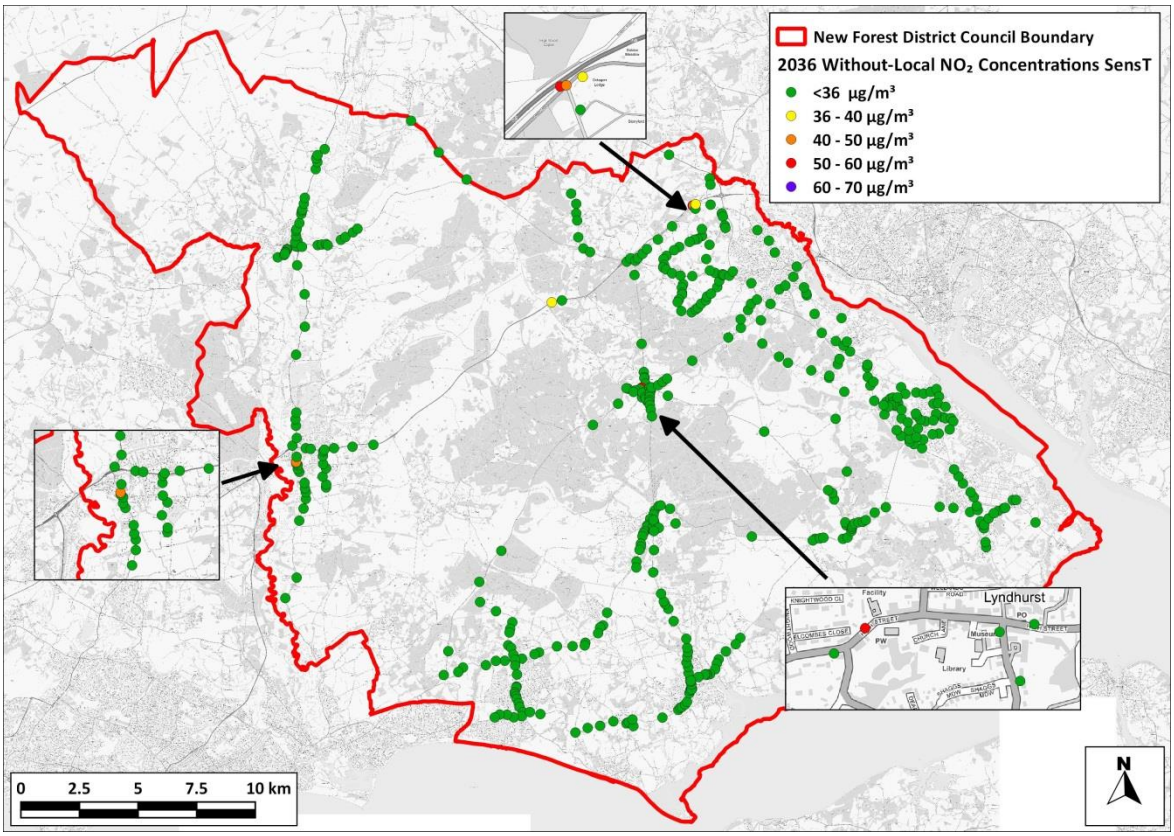


**Figure 11: 2036 Without-Local Plan Nitrogen Dioxide Concentrations Sensitivity Test (µg/m$^3$)**

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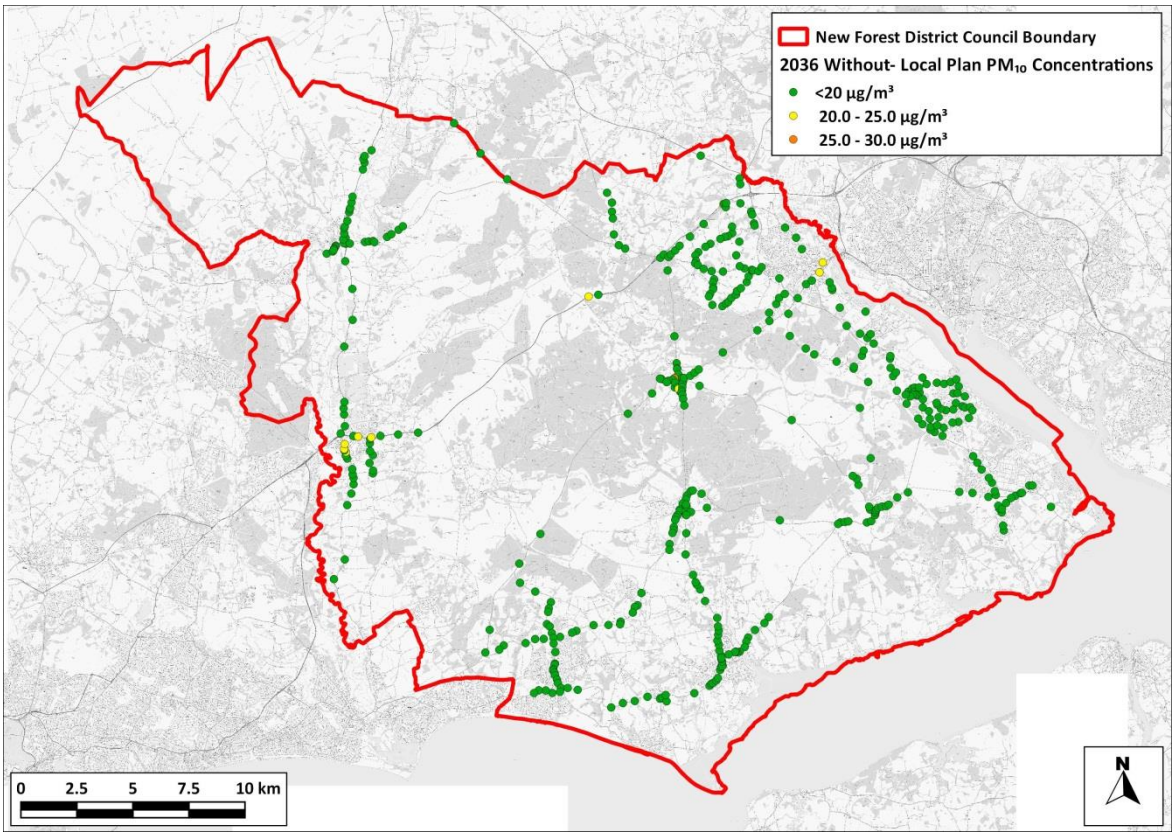


**Figure 12: 2036 Without-Local Plan $PM_{10}$ Concentrations (µg/m$^3$)**

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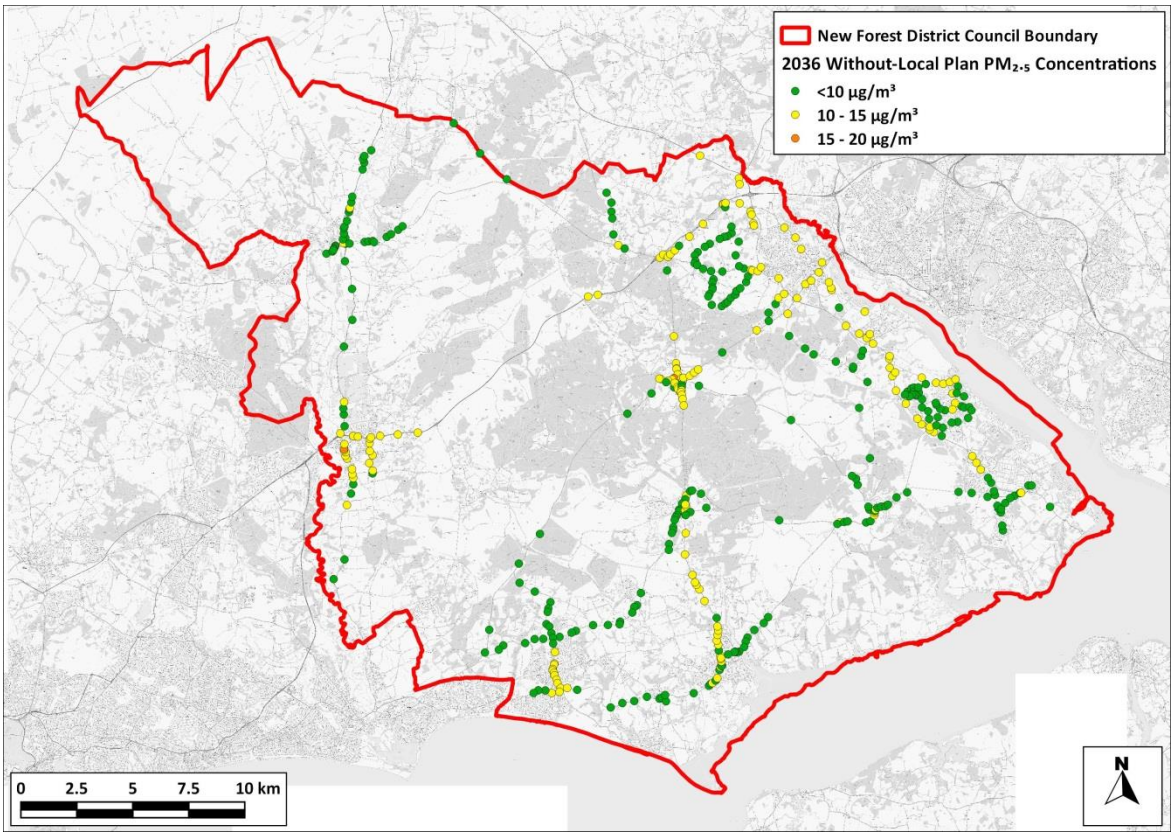


**Figure 13: 2036 Without-Local Plan $PM_{2.5}$ Concentrations (µg/m$^3$)**

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### *2015 Baseline*

4.3 Annual mean concentrations of nitrogen dioxide are predicted to be above the annual mean objective at locations close to the M27 (west of Junction 2) (65.0 µg/m$^3$), the A31 (47.4 µg/m$^3$) and in Lyndhurst (41.1 µg/m$^3$), Fordingbridge (40.5 µg/m$^3$), Ringwood (59.4 µg/m$^3$) and Totton (49.3 µg/m$^3$). At all other locations modelled concentrations are predicted to be below the annual mean objective. There is one location in close proximity to the M27, where concentrations are predicted to be above 60 µg/m$^3$. This may indicate that the 1-hour mean nitrogen dioxide objective has been exceeded at this location (see Paragraph 2.12).

4.4 Predicted concentrations of $PM_{10}$ and $PM_{2.5}$ are well below the relevant objectives in 2015 at all receptors (maximum concentrations of 25.4 µg/m$^3$ and 16.9 µg/m$^3$ respectively). The annual mean $PM_{10}$ concentrations are below 32 µg/m$^3$ [5] and it is, therefore, unlikely that the 24-hour mean $PM_{10}$ objective will be exceeded.

[5] While the annual mean $PM_{10}$ objective is 40 µg/m$^3$, 32 µg/m$^3$ is the annual mean concentration above which an exceedance of the 24-hour mean $PM_{10}$ objective is possible, as outlined in LAQM.TG16 (Defra, 2016). A value of

### *2026 Baseline*

4.5 The predicted annual mean concentrations of nitrogen dioxide are below the annual mean objective at the majority of receptor locations, the only exceedance predicted is within Lyndhurst (42.1 µg/m$^3$). All of the predictions for $PM_{10}$ and $PM_{2.5}$ are well below the objectives (maximum concentrations of 26.2 µg/m$^3$ and 16.6 µg/m$^3$ respectively). The annual mean $PM_{10}$ concentrations are below 32 µg/m$^3$ and it is, therefore, unlikely that the 24-hour mean $PM_{10}$ objective will be exceeded.

### *2036 Baseline*

4.6 The predicted annual mean concentrations of nitrogen dioxide are below the annual mean objective at all receptor locations (maximum concentration of 40.0 µg/m$^3$). All of the predictions for $PM_{10}$ and $PM_{2.5}$ are well below the objectives (maximum concentrations of 27.2 µg/m$^3$ and 17.1 µg/m$^3$ respectively). The annual mean $PM_{10}$ concentrations are below 32 µg/m$^3$ and it is, therefore, unlikely that the 24-hour mean $PM_{10}$ objective will be exceeded.

### *Worst-case Sensitivity Test for Nitrogen Dioxide*

4.7 There are additional locations close to Junction 1 of the M27 in Cadnam where concentrations are predicted to exceed the annual mean objective in the 2015 (maximum concentration 40.6 µg/m$^3$). There is an additional modelled receptor in Ringwood in the 2015 baseline sensitivity test scenario where concentrations are predicted to be above 60 µg/m$^3$ (62.1 µg/m$^3$).

4.8 In the 2026 baseline there are predicted to be additional exceedances of the annual mean objective at receptors to the west of Junction 2 (54.4 µg/m$^3$), in Lyndhurst (58.3 µg/m$^3$) and Ringwood (42.6 µg/m$^3$).

4.9 In the 2036 baseline sensitivity test scenario there are predicted to be exceedances of the annual mean objective at locations in Lyndhurst (58.1 µg/m$^3$), Ringwood (41.4 µg/m$^3$) and close to the M27 (west of Junction 2) (maximum concentration 54.4 µg/m$^3$).

---

32 µg/m$^3$ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean $PM_{10}$ objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017). The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

# 5 Impact Assessment

## Initial Screening Assessment of Development-Generated Road Traffic Emissions

5.1 The first stage of the assessment was to complete an initial screening of the proposed increases in annual mean daily traffic flows as a result of the Local Plan to identify those areas which may require further detailed assessment. The proposed increases in annual average daily traffic flows as a result of the Local Plan, as provided by Systra, have been compared to the screening criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017) (see Paragraphs A2.7 to A2.10 in Appendix A1). This identified several areas within the New Forest District, in both 2026 and 2036, where the changes in traffic flows as a result of the Local Plan were higher than the screening criteria. It was thus, necessary to progress to a more detailed assessment. For completeness receptors were selected across the district to understand current conditions and to consider the potential impacts of the Local Plan on human health receptors.

## Detailed Assessment of Development-Generated Road Traffic Emissions

### *2026*

5.2 Predicted annual mean concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ in 2026 for the modelled receptors With the Local Plan are shown in Figure 14 to Figure 17.

5.3 The potential impacts of the Local Plan at each of the modelled receptors in 2026 are shown in Figure 18 to Figure 21 using the impact descriptors given in Appendix A2. For nitrogen dioxide, results are shown for two scenarios so as to include a worst-case sensitivity test.

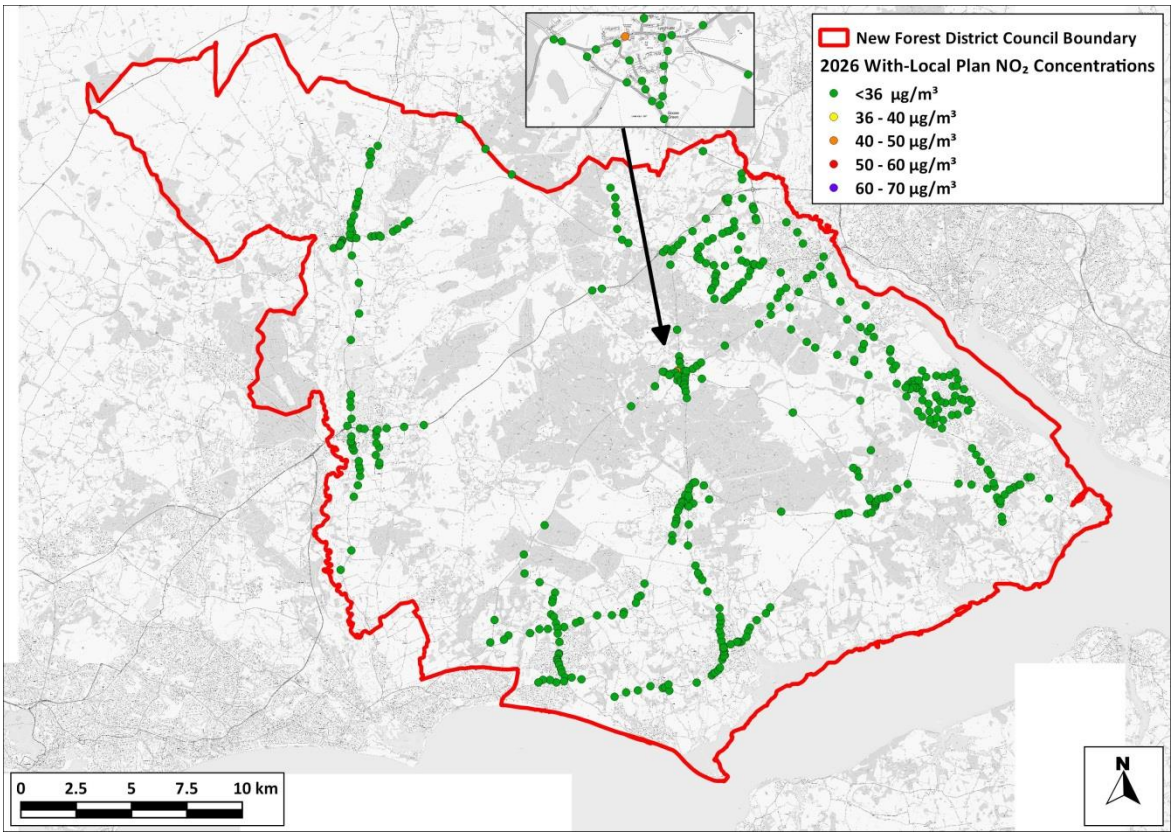


**Figure 14: 2026 With-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$)**

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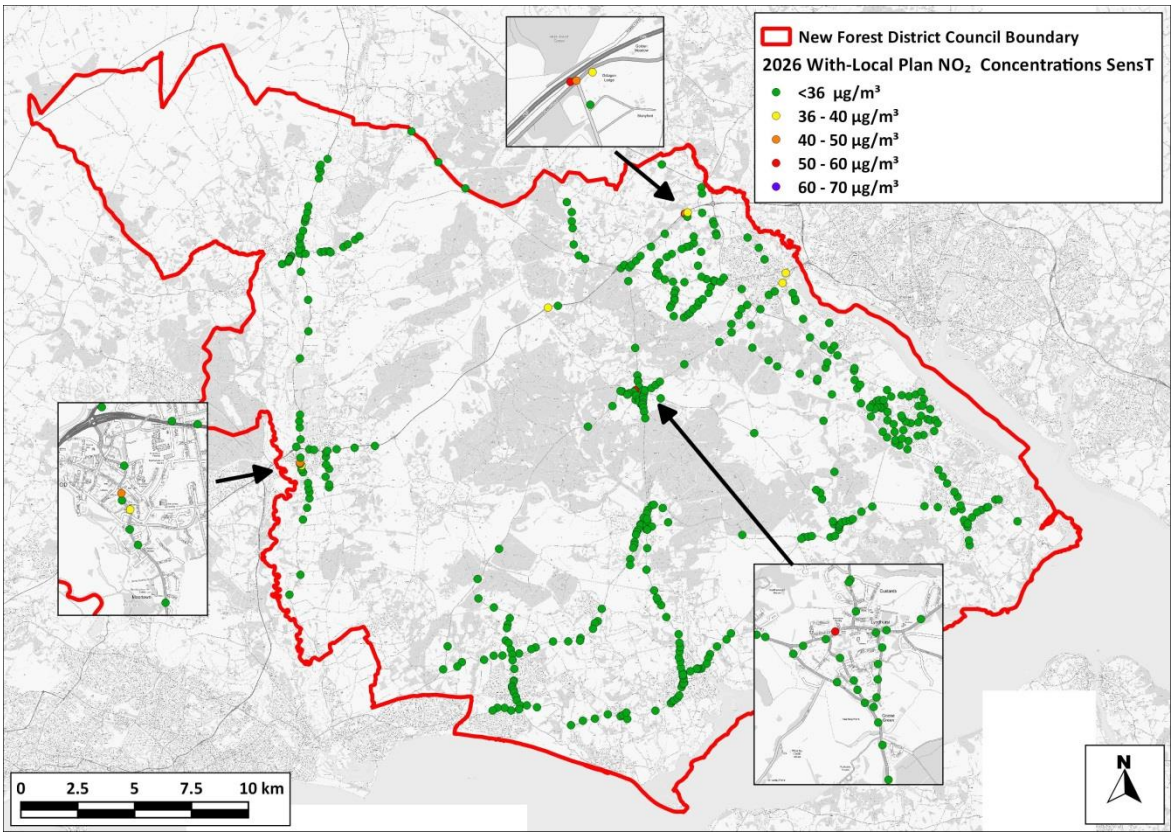


**Figure 15: 2026 With-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$) Sensitivity Test**

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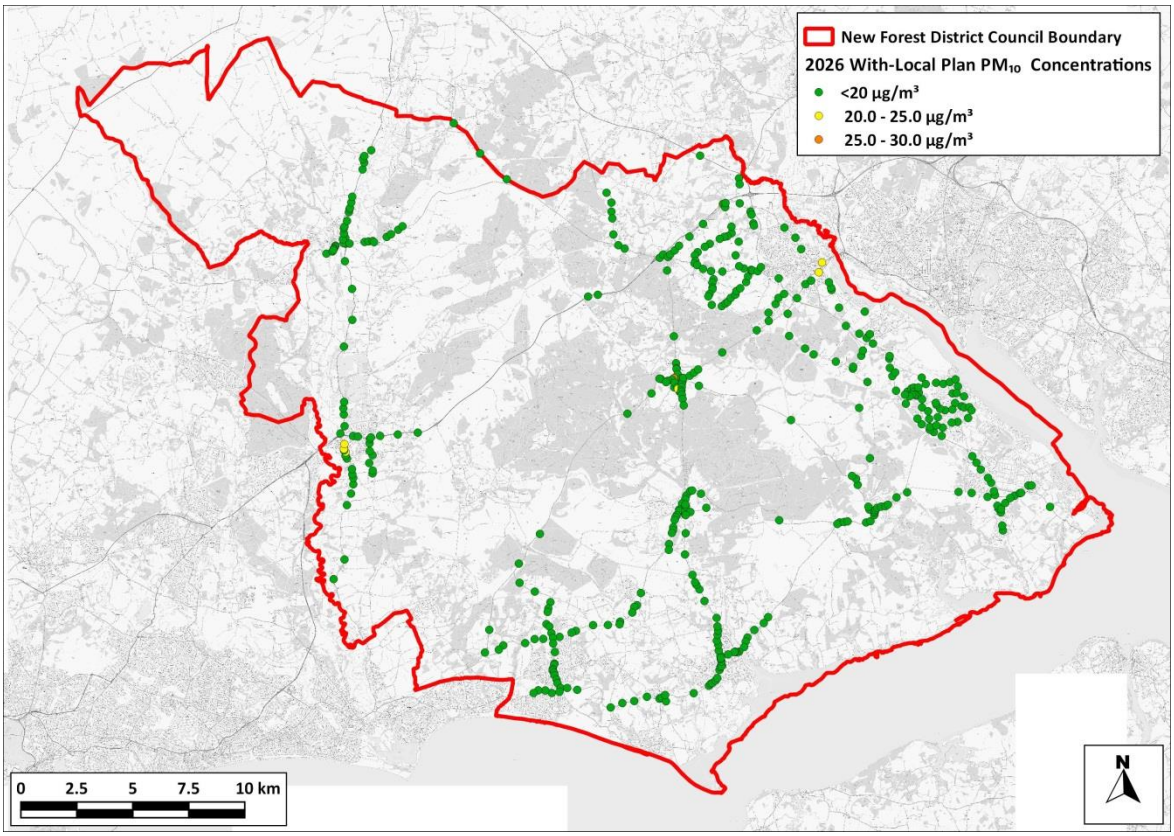


**Figure 16: 2026 With-Local Plan $PM_{10}$ Concentrations (µg/m$^3$)**

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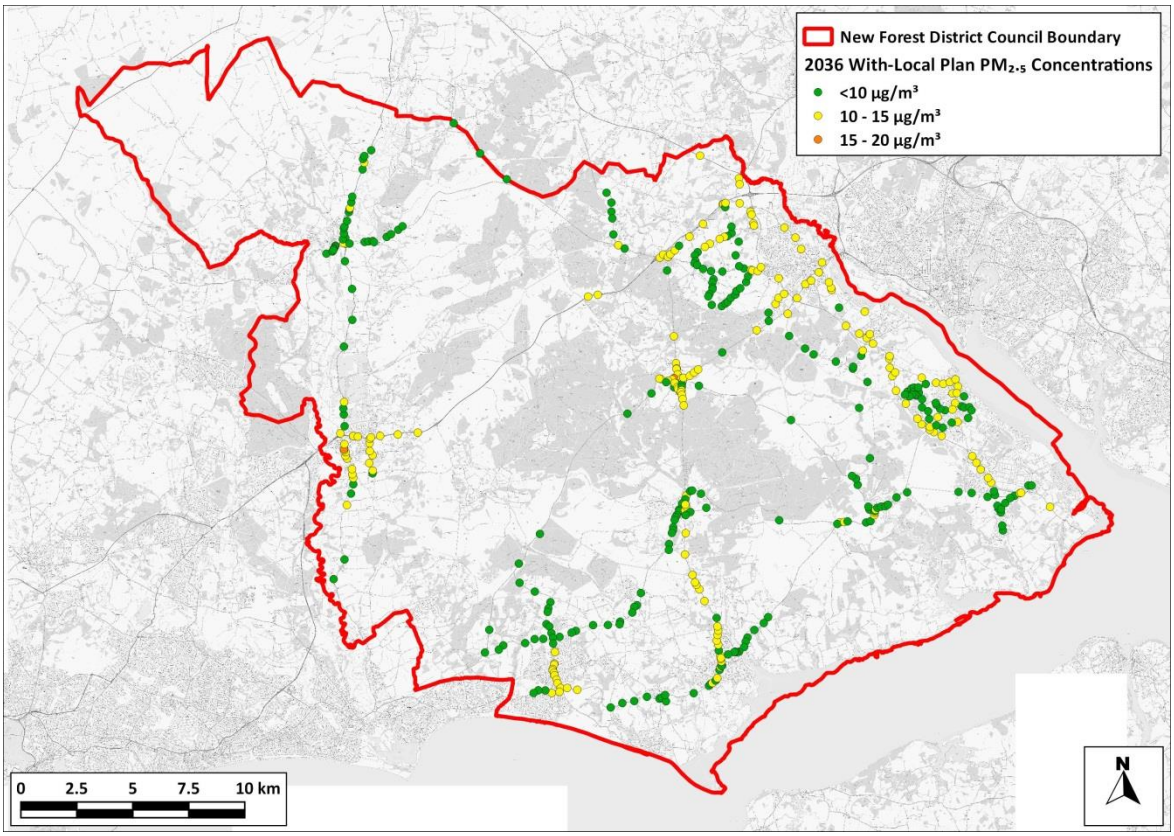


**Figure 17: 2026 With-Local Plan $PM_{2.5}$ Concentrations (µg/m$^3$)**

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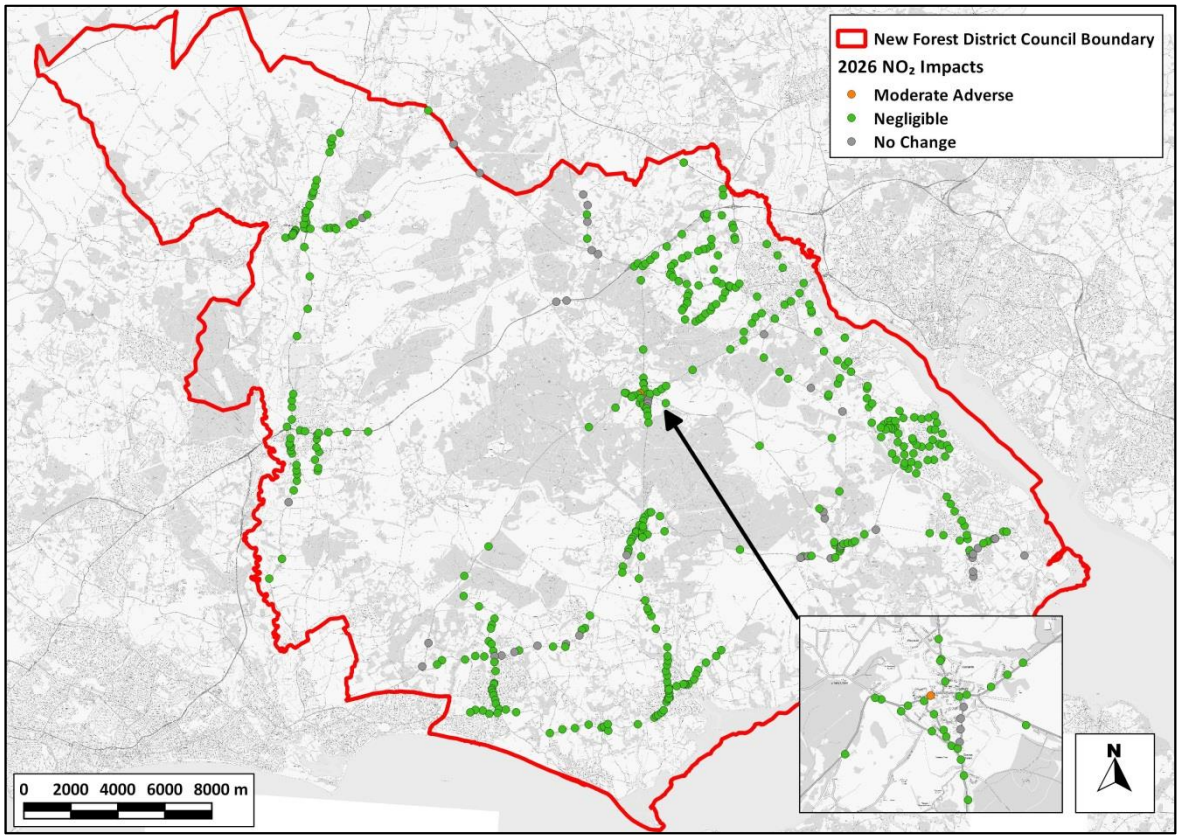


**Figure 18: 2026 Nitrogen Dioxide Impact Descriptors**

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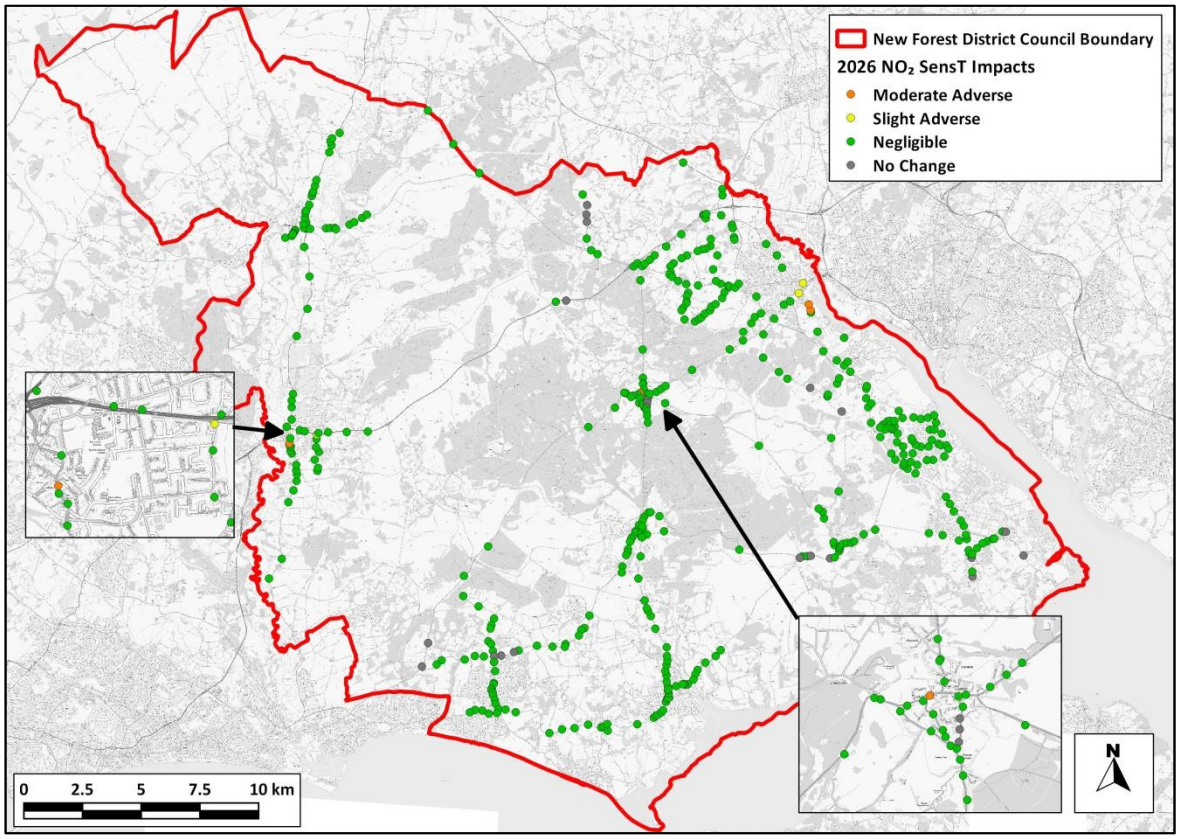


**Figure 19: 2026 Nitrogen Dioxide Sensitivity Test Impact Descriptors**

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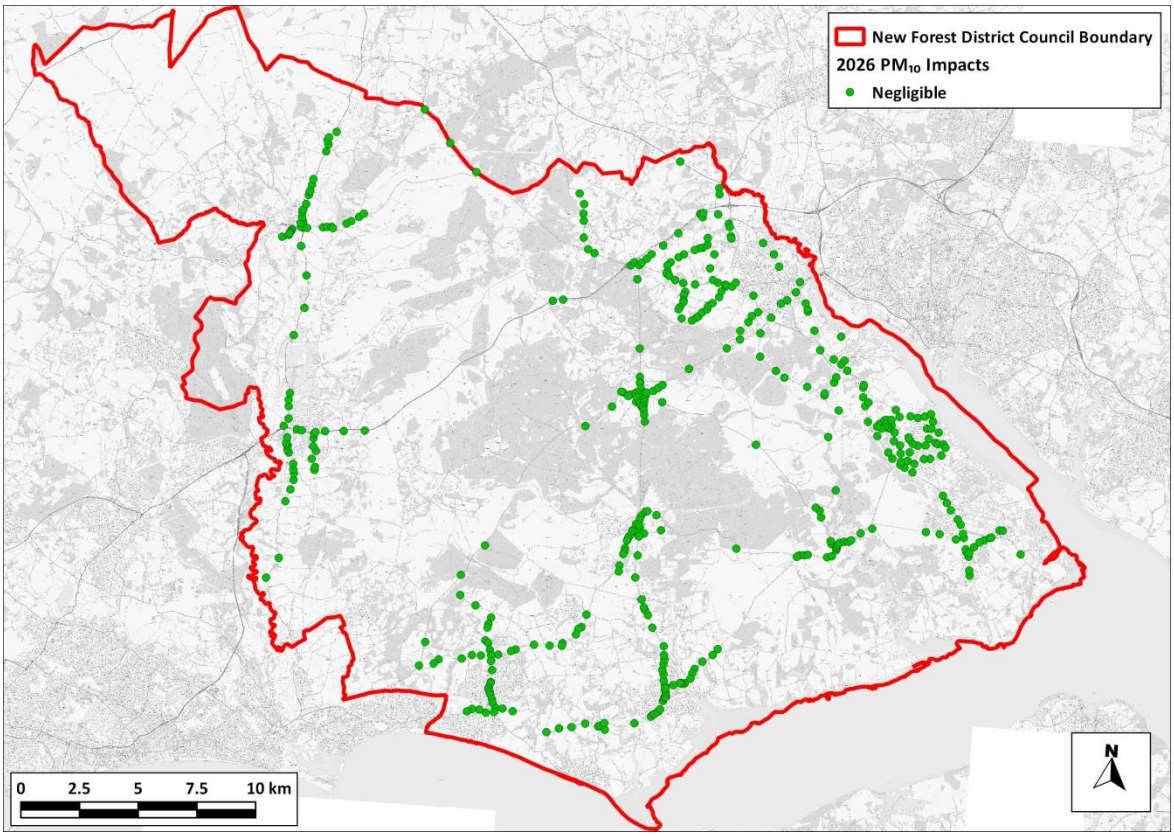


**Figure 20: 2026 $PM_{10}$ Impact Descriptors**

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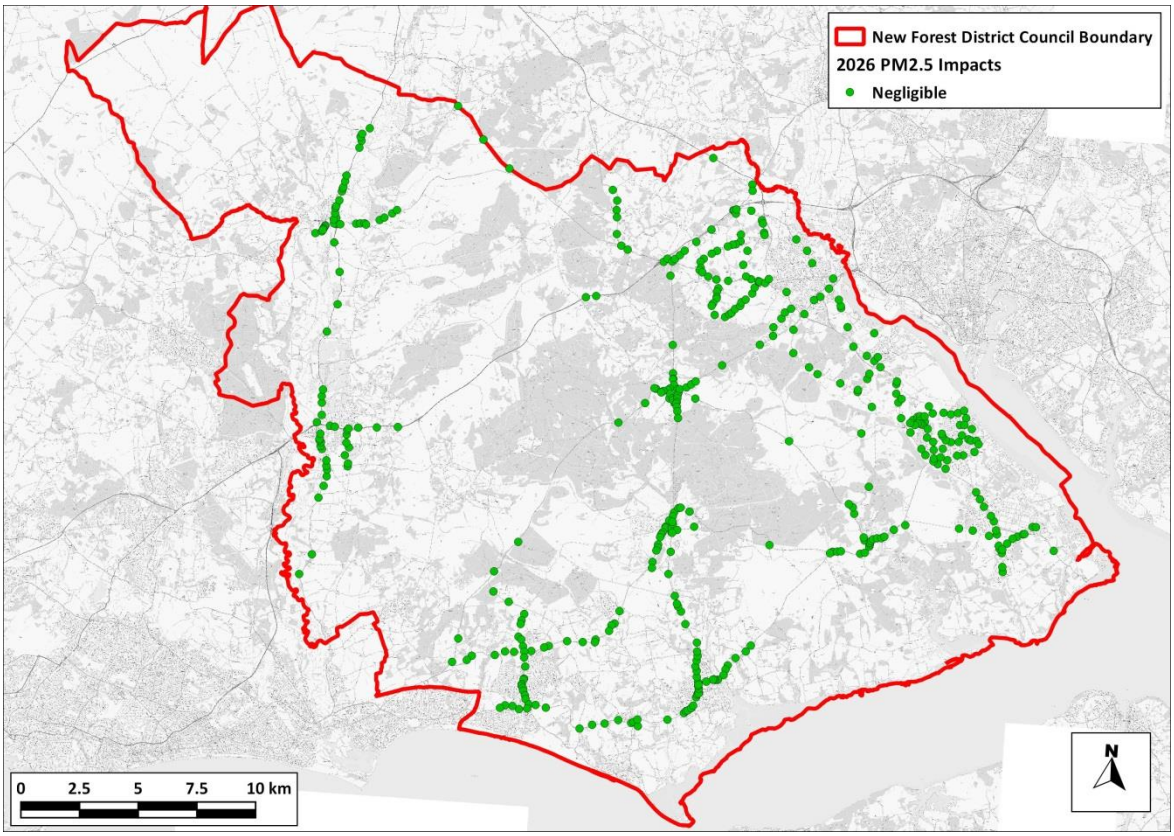


**Figure 21: 2026 $PM_{2.5}$ Impact Descriptors**

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### Nitrogen Dioxide

5.4 The annual mean nitrogen dioxide concentrations are below the objective at all receptors in 2026, except at one receptor in Lyndhurst (42.3 µg/m$^3$) with the Local Plan. The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be zero at 400 of the receptors, 1% at 21 of the receptors, 2% at seven of the receptors, 3% at two and 4% at three of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible* at 389 of the receptors, and *moderate adverse* at one of the receptors (Lyndhurst). There is predicted to be no change at 43 of the receptors.

5.5 The annual mean nitrogen dioxide concentrations are below 60 µg/m$^3$ at every receptor; it is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.12).

### Worst-case Sensitivity Test

5.6 The results from the worst-case sensitivity test show that concentrations are predicted to exceed the annual mean objective at four receptors in Lyndhurst (58.3 µg/m$^3$), Ringwood (43.0 µg/m$^3$) and in close proximity to the M27 (to the west of Junction 2) (maximum concentration of 54.4 µg/m$^3$).

The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be zero at 378 of the receptors, 1% at 34 of the receptors, 2% at 11 of the receptors, 3% at five of the receptors, 4% at one of the receptors, 5% at two of the receptors and 6% at two of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible* at 404 of the receptors, *slight adverse* at three of the receptors and *moderate adverse* at four of the receptors. There is predicted to be no change at 22 of the receptors.

#### $PM_{10}$ and $PM_{2.5}$

5.7 The annual mean $PM_{10}$ and $PM_{2.5}$ concentrations are well below the relevant criteria at all receptors, with the Local Plan in place (maximum concentrations of 26.3 µg/m$^3$ and 16.7 µg/m$^3$ respectively). Furthermore, as the annual mean $PM_{10}$ concentrations are below 32 µg/m$^3$, it is unlikely that the 24-hour mean $PM_{10}$ objective will be exceeded at any of the receptors.

5.8 The percentage changes in $PM_{10}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be zero at 414 of the receptors, 1% at 15 of the receptors and 2% at four of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible.*

5.9 The percentage changes in $PM_{2.5}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be zero at 420 of the receptors, 1% at 12 of the receptors and 2% at one of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible.*

### *2036*

5.10 Predicted annual mean concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ in 2036 for the modelled receptors With the Local Plan are shown in Figure 22 to Figure 25.

5.11 The impacts at each of the modelled receptors in 2036 are shown in Figure 26 to Figure 29 using the impact descriptors given in Appendix A1. For nitrogen dioxide, results are shown for two scenarios so as to include a worst-case sensitivity test.

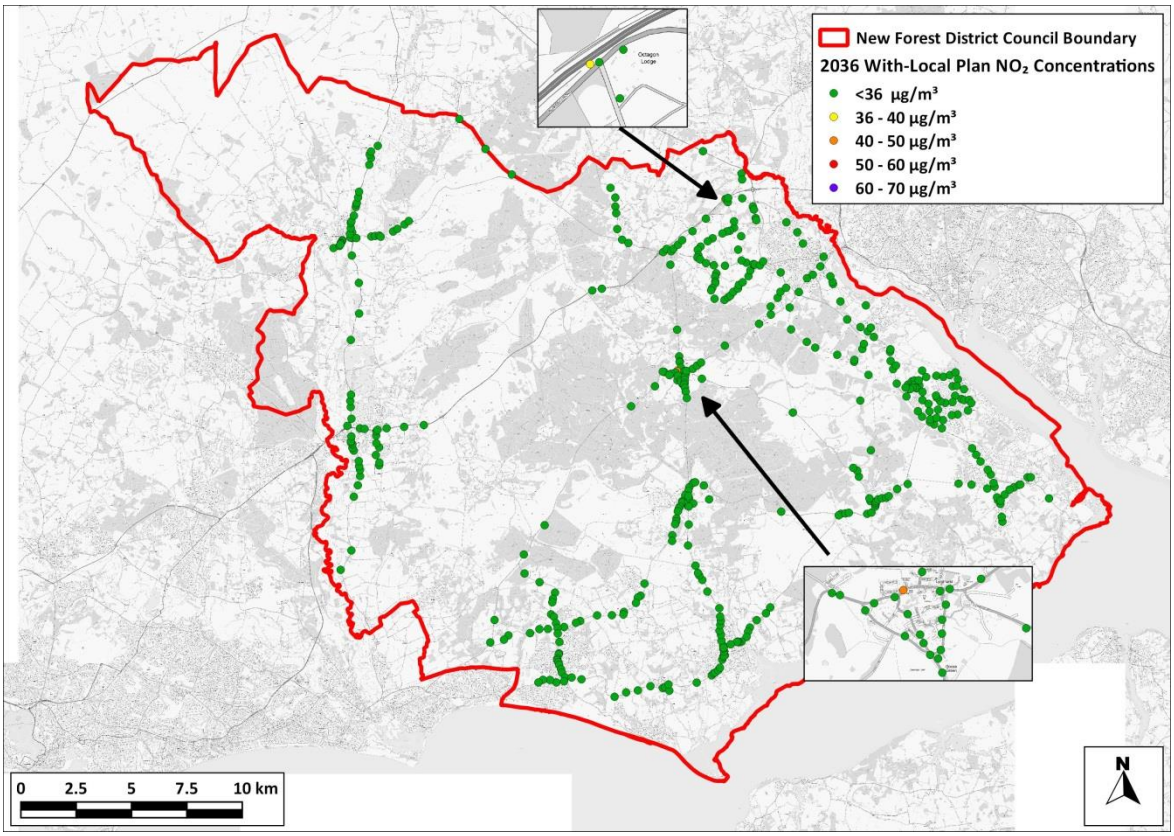


**Figure 22: 2036 With-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$)**

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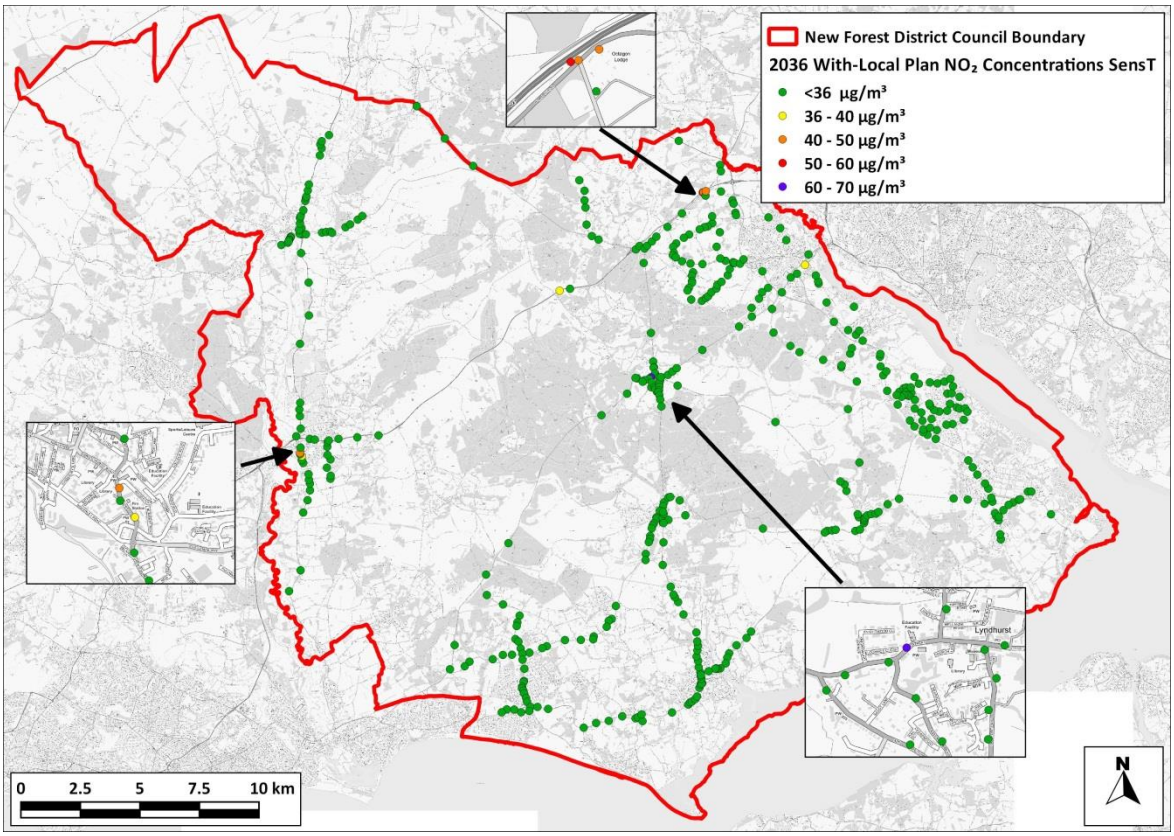


**Figure 23: 2036 With-Local Plan Nitrogen Dioxide Concentrations (µg/m$^3$) Sensitivity Test**

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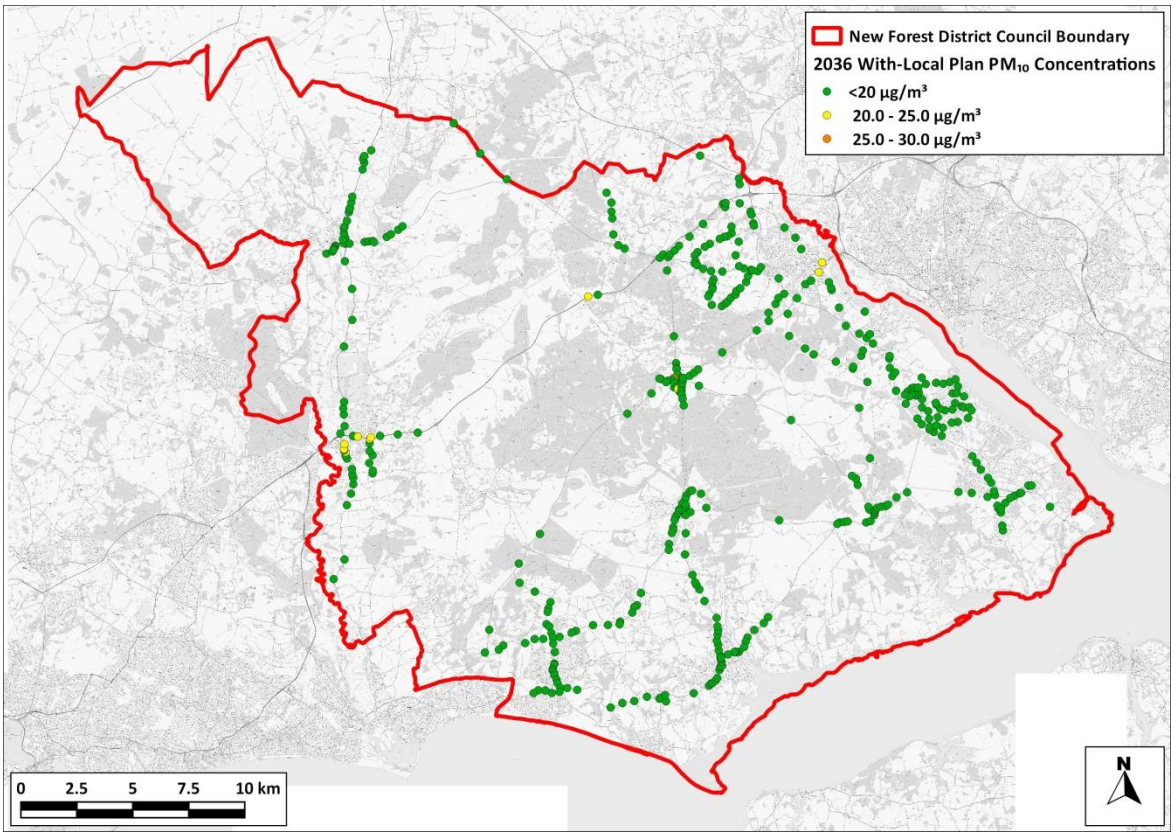


**Figure 24: 2036 With-Local Plan $PM_{10}$ Concentrations (µg/m$^3$)**

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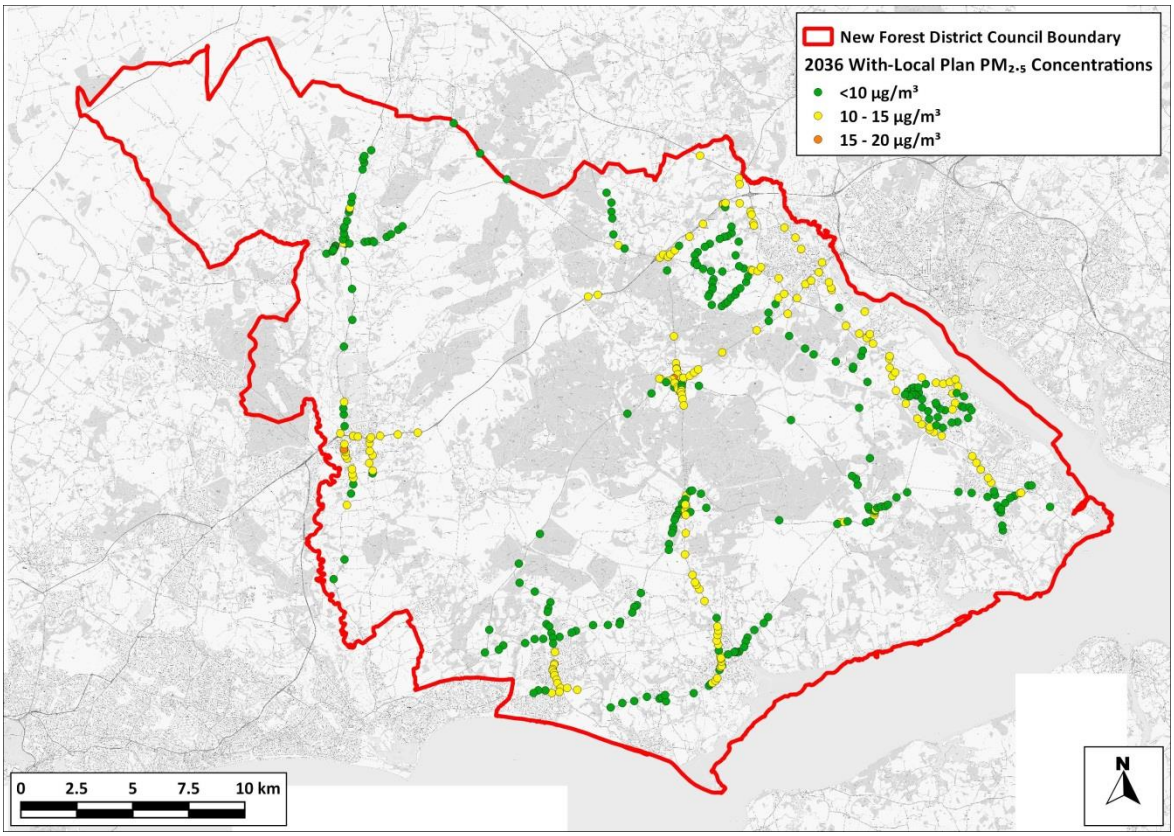


**Figure 25: 2036 With-Local Plan $PM_{2.5}$ Concentrations (µg/m$^3$)**

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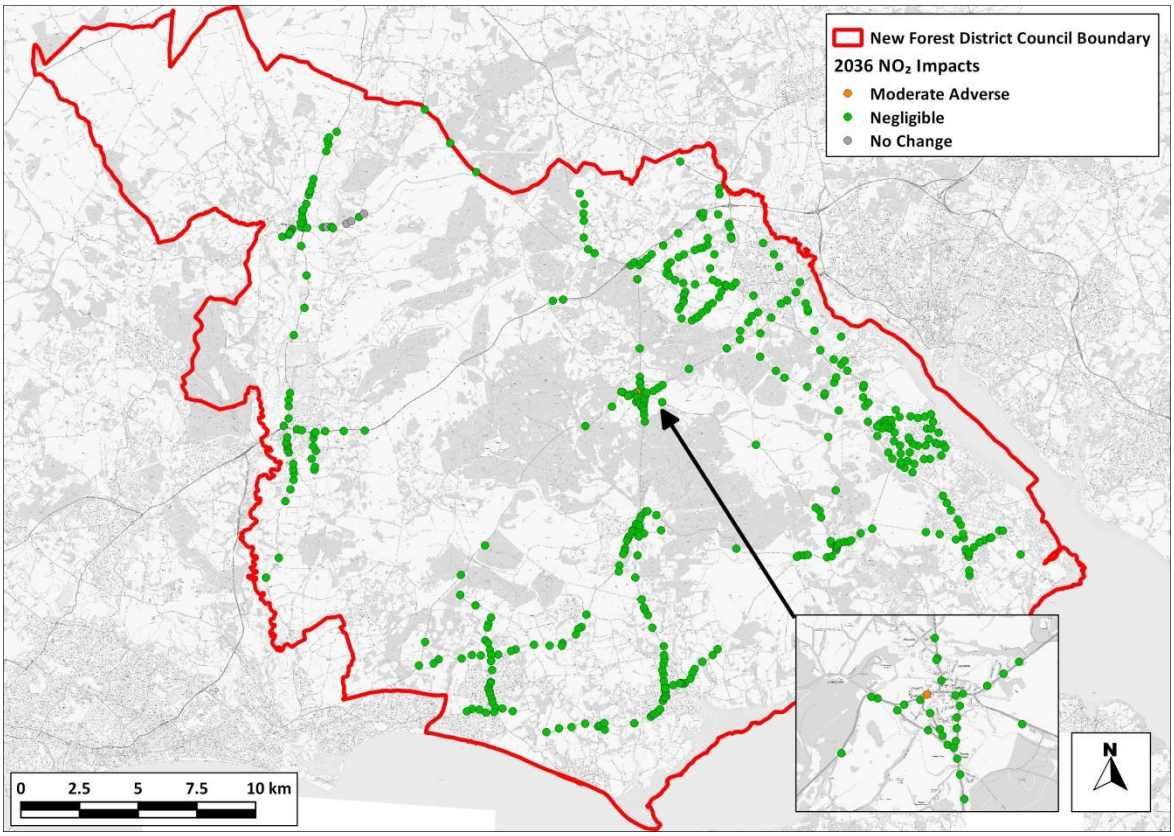


**Figure 26: 2036 Nitrogen Dioxide Impact Descriptors**

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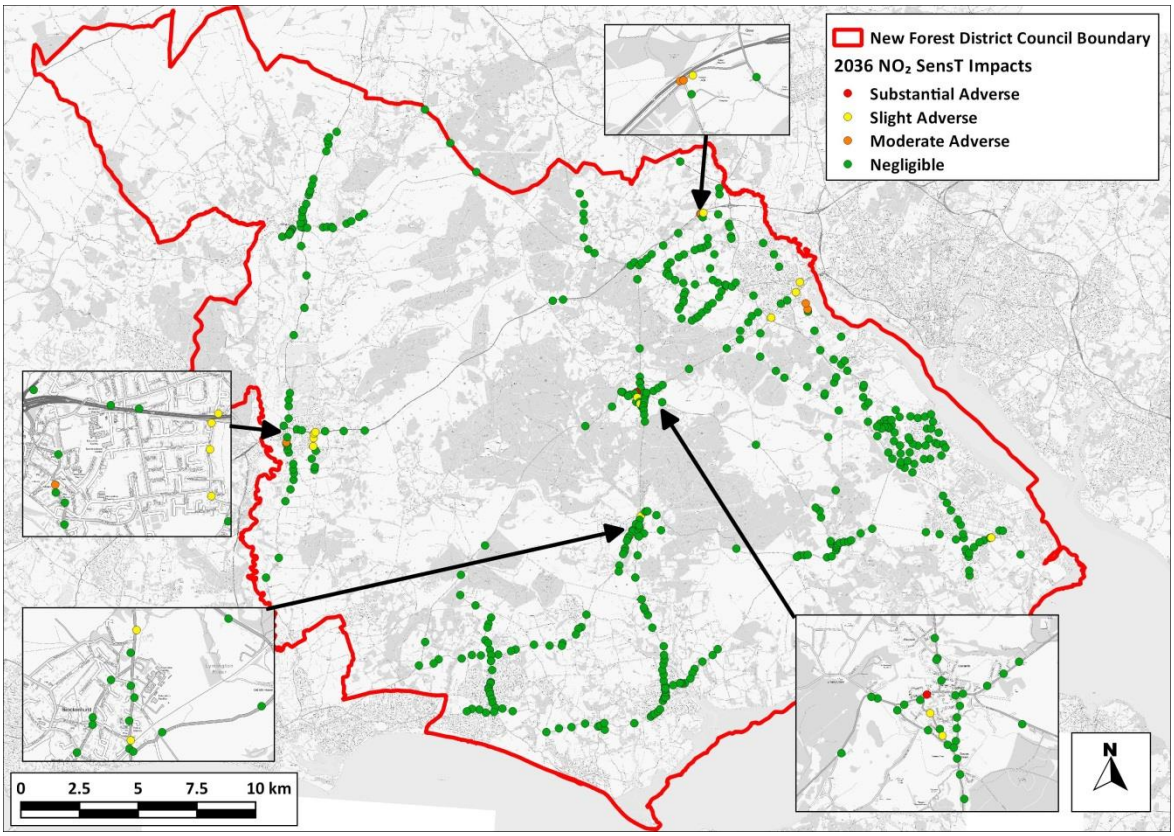


**Figure 27: 2036 Nitrogen Dioxide Sensitivity Test Impact Descriptors**

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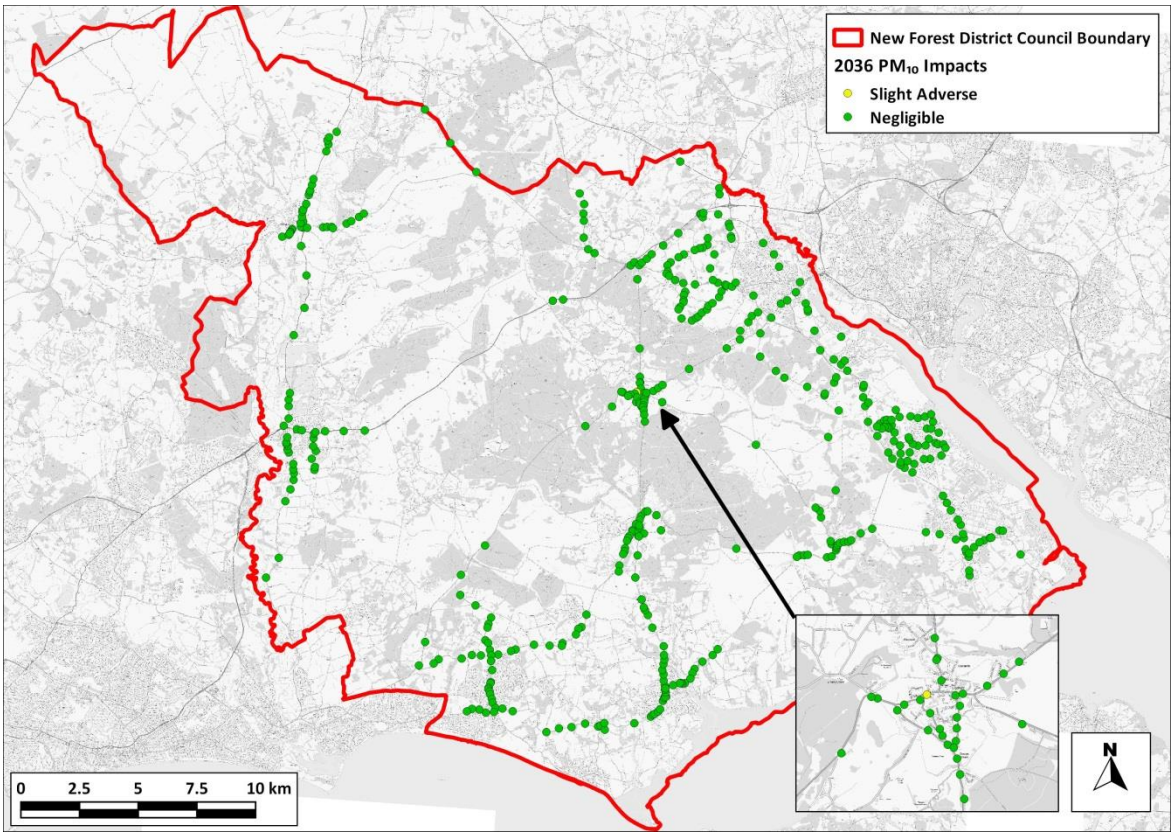


**Figure 28: 2036 $PM_{10}$ Impact Descriptors**

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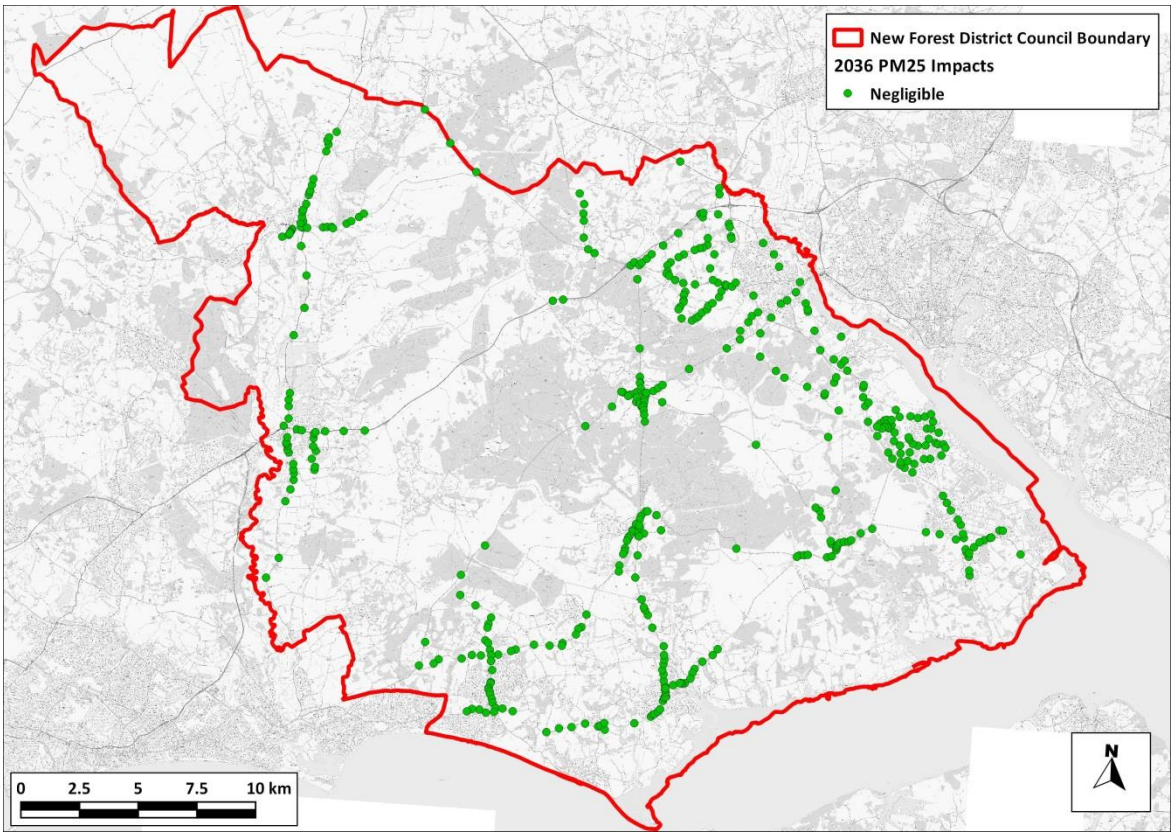


**Figure 29: 2036 $PM_{2.5}$ Impact Descriptors**

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### Nitrogen Dioxide

5.12 The annual mean nitrogen dioxide concentrations are below the objective at all receptors in 2036 with the Local Plan, except at one receptor in Lyndhurst (41.9 µg/m$^3$). The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be zero at 221 of the receptors, 1% at 164 of the receptors, 2% at 36 of the receptors, 3% at six, 4% at one of the receptors and 5% at five of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible* at 428 of the receptors and *moderate adverse* at one of the receptors. There is predicted to be no change at four of the receptors

5.13 The annual mean nitrogen dioxide concentrations are below 60 µg/m$^3$ at every receptor; it is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.12).

### Worst-case Sensitivity Test

5.14 The results from the worst-case sensitivity test show that concentrations are predicted to exceed the annual mean objective at five receptors in Lyndhurst (60.8 µg/m$^3$), Ringwood (42.0 µg/m$^3$) and in close proximity to the M27 (west of Junction 2) (maximum concentration of 54.8 µg/m$^3$). The

percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be zero at 135 of the receptors, 1% at 182 of the receptors, 2% at 75 of the receptors, 3% at 27 of the receptors, 4% at five of the receptors, 5% at three of the receptors, 7% at three of the receptors and 8% at three of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible* at 414 of the receptors, *slight adverse* at 13 of the receptors, *moderate adverse* at five of the receptors and substantial at one of the receptors.

5.15 At one location in Lyndhurst the annual mean nitrogen dioxide concentration is predicted to be above 60 µg/m$^3$; which may imply that the 1-hour mean nitrogen dioxide objective may be exceeded (see Paragraph 2.12).

#### $PM_{10}$ and $PM_{2.5}$

5.16 The annual mean $PM_{10}$ and $PM_{2.5}$ concentrations are well below the relevant criteria at all receptors, with the Local Plan in place (maximum concentrations of 28.0 µg/m$^3$ and 17.5 µg/m$^3$ respectively). Furthermore, as the annual mean $PM_{10}$ concentrations are below 32 µg/m$^3$, it is unlikely that the 24-hour mean $PM_{10}$ objective will be exceeded at any of the receptors.

5.17 The percentage changes in $PM_{10}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be zero at 317 of the receptors, 1% at 105 of the receptors, 2% at seven of the receptors, 3% at three of the receptors and 4% at one of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible* at 432 receptors and *slight adverse* at one of the receptors (although the concentration remains below the objective at this receptor).

5.18 The percentage changes in $PM_{2.5}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be zero at 375 of the receptors, 1% at 50 of the receptors and 2% at eight of the receptors. Using the matrix in Table A2.1 (Appendix A1), these impacts are described as *negligible.*

## Summary of Impacts of the Local Plan

### *2026*

5.19 In 2026, for the worst-case sensitivity test, there are predicted to be exceedances of the annual mean nitrogen dioxide objective at relevant receptors within Ringwood (43.0 µg/m$^3$), Lyndhurst (58.6 µg/m$^3$) and to the west of Junction 2 of the M27 (maximum concentration 54.4 µg/m$^3$). These exceedances occur with and without the Local Plan. The impacts are described as *negligible* to *moderate adverse*. This also assumes that all traffic associated with the Local Plan development up 2026 will be on the local road network which due to the phased nature of development in the area may not occur.

5.20 Assuming, vehicle emissions reduce at the 'official rate', the only exceedance is predicted to occur in Lyndhurst (42.3 µg/m$^3$), this exceedance occurs both without and with the Local Plan. The impacts range from *negligible* to *moderate adverse* (*moderate adverse* at one receptor). This also assumes that all traffic associated with the Local Plan development up 2026 will be on the local road network which due to the phased nature of development in the area may not occur.

5.21 There are predicted to be no exceedances of the $PM_{10}$ and $PM_{2.5}$ objectives in 2026 with the Local Plan in place. The impacts for $PM_{10}$ are predominantly described as *negligible* with *slight adverse* impacts at one of the receptors. For $PM_{2.5}$ the impacts are all described as *negligible.*

### *2036*

5.22 In 2036, for the worst-case sensitivity test, there are predicted to be exceedances of the annual mean nitrogen dioxide objective at relevant receptors within Lyndhurst (60.8 µg/m$^3$), Ringwood (42.0 µg/m$^3$) and to the west of Junction 2 of the M27 (maximum concentration 54.8 µg/m$^3$). These exceedances occur both with and without the Local Plan at all receptors except for one location near to the M27. The impacts are described as *negligible* to *substantial* (*substantial* only occurs at one receptor). This also assumes that all traffic associated with the Local Plan development up 2036 will be on the local road network which due to the phased nature of development in the area may not occur.

5.23 Assuming, vehicle emissions reduce at the 'official rate', the only exceedance is predicted to occur in Lyndhurst (41.9 µg/m$^3$), this exceedance is a result of the Local Plan. The impacts are described as *negligible* to *moderate adverse* (*moderate adverse* at one receptor). Again, this scenario assumes that all traffic associated with the Local Plan development up 2036 will be on the local road network which due to the phased nature of development in the area may not occur.

5.24 There are predicted to be no exceedances of the $PM_{10}$ and $PM_{2.5}$ objectives in 2036 with the Local Plan in place. The impacts for $PM_{10}$ are predominantly described as *negligible* with *slight adverse* impacts at one of the receptors. For $PM_{2.5}$ the impacts are all described as *negligible.*

# 6 Conclusions

6.1 An air quality assessment has been carried out to determine the potential air quality impacts on relevant receptors in relation to the human health objectives. The assessment has been completed to provide New Forest District Council with information on potential areas of air quality concern associated with the proposed New Forest District Council Local Plan.

6.2 Concentrations of nitrogen dioxide, $PM_{10}$ and $PM_{2.5}$ have been predicted at a total of 433 relevant receptors across the district. The assessment has covered two alternative future-year scenarios; 2026, which represents a mid-point in the Local Plan period, and 2036, which represents the year of plan completion.

6.3 In terms of vehicle emissions, two future-year scenarios have been considered; one where emissions per vehicle are assumed to reduce in-line with Defra's forecast; and one where emissions per vehicle reduce at a slower rate than has been assumed by Defra, taking into account the observed under-performance of modern diesel vehicles.

6.4 The predicted concentrations in 2015 highlight several areas where concentrations are predicted to exceed the annual mean nitrogen dioxide objective in locations not previously identified by New Forest District Council; namely Ringwood and at locations close to the M27. It is advised that the diffusion tube network currently operated by New Forest District Council is extended to include locations within these areas to better understand current conditions.

6.5 It is concluded that concentrations of $PM_{10}$ and $PM_{2.5}$ will remain below the objectives at all modelled receptors in both 2026 and 2036, even with the additional traffic associated with the Local Plan. In both 2026 and 2036, the impacts for $PM_{10}$ are predominantly *negligible* (*slight adverse* at one receptor) and for $PM_{2.5}$ the impacts are all *negligible.*

6.6 In 2026, for the worst-case sensitivity test, predicted exceedances of the annual mean nitrogen dioxide objective occur at relevant receptors within Lyndhurst, Ringwood and to the west of Junction 2 of the M27. These exceedances occur both with and without the Local Plan. The impacts are described as *negligible* to *moderate adverse*. Assuming, vehicle emissions reduce at the 'official rate', the only exceedance is predicted to occur in Lyndhurst, again this exceedance occurs both with and without the Local Plan. The impacts range from *negligible* to *moderate adverse* (*moderate adverse* at one receptor).

6.7 In 2036, for the worst-case sensitivity test, there are predicted to be exceedances of the annual mean nitrogen dioxide objective at relevant receptors within Lyndhurst, Ringwood and to the west of Junction 2 of the M27. These exceedances occur both with and without the Local Plan at all receptors except for one location near to the M27. The impacts are described as *negligible* to *substantial* (*substantial* only occurs at one receptor). Assuming, vehicle emissions reduce at the

'official rate', the only exceedance is predicted to occur in Lyndhurst, this exceedance is a result of the Local Plan. The impacts are described as negligible to moderate adverse (moderate adverse at one receptor).

6.8 The overall conclusions set out in this section, when focussing on the sensitivity test results for 2026 and the EFT v7 results for 2036, would be unchanged had the recently published updated emission factors in EFT v8 been used (see footnote 2 on page 10).

# 7 References

AQC (2016a) *CURED V2A*, Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/CURED-V2A.zip.aspx.

AQC (2016b) *Emissions of Nitrogen Oxides from Modern Diesel Vehicles*, Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/Emissions-of-Nitrogen-Oxides-from-Modern-Diesel-Vehicles-210116.pdf.aspx.

AQC (2016c) *Adjusting Background NO2 Maps for CUREDV2A*, Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/Adjusting-Background-NO2-Maps-for-CURED-September-2016.pdf.aspx.

Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011) *Trends in NOx and NO2 emissions and ambient measurements in the UK*, Available: uk-air.defra.gov.uk/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf.

Carslaw, D. and Rhys-Tyler, G. (2013) *Remote sensing of NO2 exhaust emissions from road vehicles*, Available: http://uk-air.defra.gov.uk/assets/documents/reports/cat05/1307161149_130715_DefraRemoteSensingReport_Final.pdf.

DCLG (2012) *National Planning Policy Framework*, DCLG, Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf.

DCLG (2017) *Planning Practice Guidance*, [Online], Available: http://planningguidance.planningportal.gov.uk/blog/guidance/.

Defra (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Defra.

Defra (2016) *Review & Assessment: Technical Guidance LAQM.TG16*, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf.

Defra (2017a) *Air quality plan for nitrogen dioxide (NO2) in the UK*, Available: https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017.

Defra (2017a) *Defra Air Quality Website*, [Online], Available: http://laqm.defra.gov.uk/.

Defra (2017c) *Defra Air Quality Website*, [Online], Available: http://laqm.defra.gov.uk/.

DfT (2015) *DfT Automatic traffic Counters Table TRA0305-0307*, [Online], Available: https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow.

Moorcroft and Barrowcliffe et al (2017) *Land-Use Planning & Development Control: Planning For Air Quality v1.2*, IAQM, London, Available: http://iaqm.co.uk/guidance/.

New Forest Distict Council (2008) *Lyndhurst Air Quality Action Plan 2008*.

New Forest District Council (2009) *New Forest District Council Local Development Framework Core Strategy New Forest District outside the National Park*.

New Forest National Park (2010) *New Forest National Park Local Development Framework Core Strategy and Development Management Policies DPD*.

*The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043* (2002), HMSO, Available: https://www.legislation.gov.uk/uksi/2002/3043/contents/made.

*The Air Quality (England) Regulations 2000 Statutory Instrument 928* (2000), HMSO, Available: http://www.legislation.gov.uk/uksi/2000/928/contents/made.

The European Parliament and the Council of the European Union (2008) *Directive 2008/50/EC of the European Parliament and of the Council*, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.

# 8 Glossary

| | |
|---|---|
| **AADT** | Annual Average Daily Traffic |
| **ADMS-Roads** | Atmospheric Dispersion Modelling System model for Roads |
| **AQC** | Air Quality Consultants |
| **AQAL** | Air Quality Assessment Level |
| **AQMA** | Air Quality Management Area |
| **CURED** | Calculator Using Realistic Emissions for Diesels |
| **DCLG** | Department for Communities and Local Government |
| **Defra** | Department for Environment, Food and Rural Affairs |
| **DfT** | Department for Transport |
| **EFT** | Emission Factor Toolkit |
| **EPUK** | Environmental Protection UK |
| **Exceedance** | A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure |
| **HDV** | Heavy Duty Vehicles (> 3.5 tonnes) |
| **HMSO** | Her Majesty's Stationery Office |
| **HGV** | Heavy Goods Vehicle |
| **IAQM** | Institute of Air Quality Management |
| **kph** | Kilometres Per hour |
| **LAQM** | Local Air Quality Management |
| **LDV** | Light Duty Vehicles (<3.5 tonnes) |
| **µg/m$^3$** | Microgrammes per cubic metre |
| **NO** | Nitric oxide |
| **$NO_2$** | Nitrogen dioxide |
| **NOx** | Nitrogen oxides (taken to be $NO_2$ + NO) |
| **NPPF** | National Planning Policy Framework |
| **Objectives** | A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the |

| | |
|---|---|
| | standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides |
| **$PM_{10}$** | Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter |
| **$PM_{2.5}$** | Small airborne particles less than 2.5 micrometres in aerodynamic diameter |
| **PPG** | Planning Practice Guidance |
| **Standards** | A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal |

# 9 Appendices

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# A1 Professional Experience

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

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM10, PM2.5 and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

## Caroline Odbert, BA (Hons) MSc CSci MIEnvSc MIAQM

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

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

# A2 EPUK & IAQM Planning for Air Quality Guidance

A2.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

## Air Quality as a Material Consideration

*"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:*

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

## Recommended Best Practice

A2.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

*"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".*

A2.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 $m^2$ of commercial floorspace;
- are carried out on land of 1 ha or more.

A2.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;

- Wherever possible, new developments should not create a new “street canyon”, as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 $m^2$ of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/$Nm^3$;
    - Compression ignition engine: 400 mgNOx/$Nm^3$;
    - Gas turbine: 50 mgNOx/$Nm^3$.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/$Nm^3$ and 25 mgPM/$Nm^3$.

A2.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

*“It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the “damage cost approach” used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential”.*

A2.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to

offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

## Screening

### *Impacts of the Local Area on the Development*

*"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:*

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

### *Impacts of the Development on the Local Area*

A2.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 $m^2$ of floor space for all other uses or a site area greater than 1 ha.

A2.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or

- the development will have a centralised energy facility or other centralised combustion process.

A2.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor; and

A2.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A2.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

*"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm$^3$.*

*In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent*

*buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.*

*Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".*

A2.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

*"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".*

A2.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

*"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".*

A2.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

## Impact Descriptors and Assessment of Significance

A2.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

### *Impact Descriptors*

A2.16 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A2.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

**Table A2.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]**

| Long-Term Average Concentration At Receptor In Assessment Year [b] | Change in concentration relative to AQAL [c] | | | | |
|---|---|---|---|---|---|
| | 0% | 1% | 2-5% | 6-10% | >10% |
| **75% or less of AQAL** | Negligible | Negligible | Negligible | Slight | Moderate |
| **76-94% of AQAL** | Negligible | Negligible | Slight | Moderate | Moderate |
| **95-102% of AQAL** | Negligible | Slight | Moderate | Moderate | Substantial |
| **103-109% of AQAL** | Negligible | Moderate | Moderate | Substantial | Substantial |
| **110% or more of AQAL** | Negligible | Moderate | Substantial | Substantial | Substantial |

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

### *Assessment of Significance*

A2.17 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*'

impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and

- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A2.18 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A2.19 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A1.

# A3 Modelling Methodology

## Model Inputs

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 7.0) published by Defra (2017a).

A3.2 Hourly sequential meteorological data from Bournemouth for 2015 have been used in the model. The Bournemouth meteorological monitoring station is located inland, approximately 24 km to the south west of the centre of the New Forest, and is considered representative of meteorological conditions across the study area.

A3.3 AADT flows, proportions of HDVs and speed data have been provided by Systra, who have undertaken the transport assessment for the Local Plan proposals in the New Forest. Where necessary, such as at roundabouts, traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. Traffic data for nearly 600 road links were provided for the assessment; for simplicity these have been omitted from the report, however are available upon request. Changes in AADT flows, between the baseline and With-Local Plan scenarios, and the modelled road network are summarised in Figure A3.1 and Figure A3.2 for 2026 and 2036 respectively.

A3.4 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

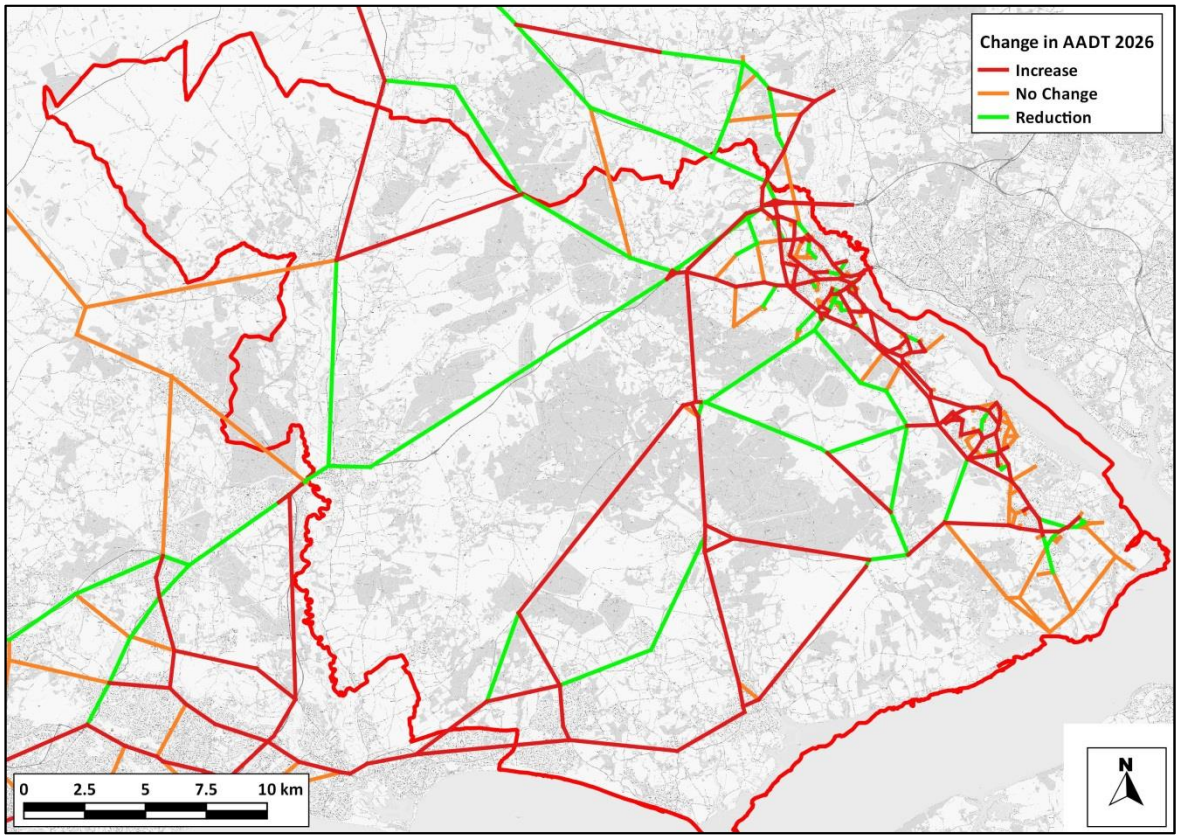


**Figure A3.1: Modelled Road Network and Changes in AADT Flows between Baseline and With-Local Plan Scenarios for 2026**

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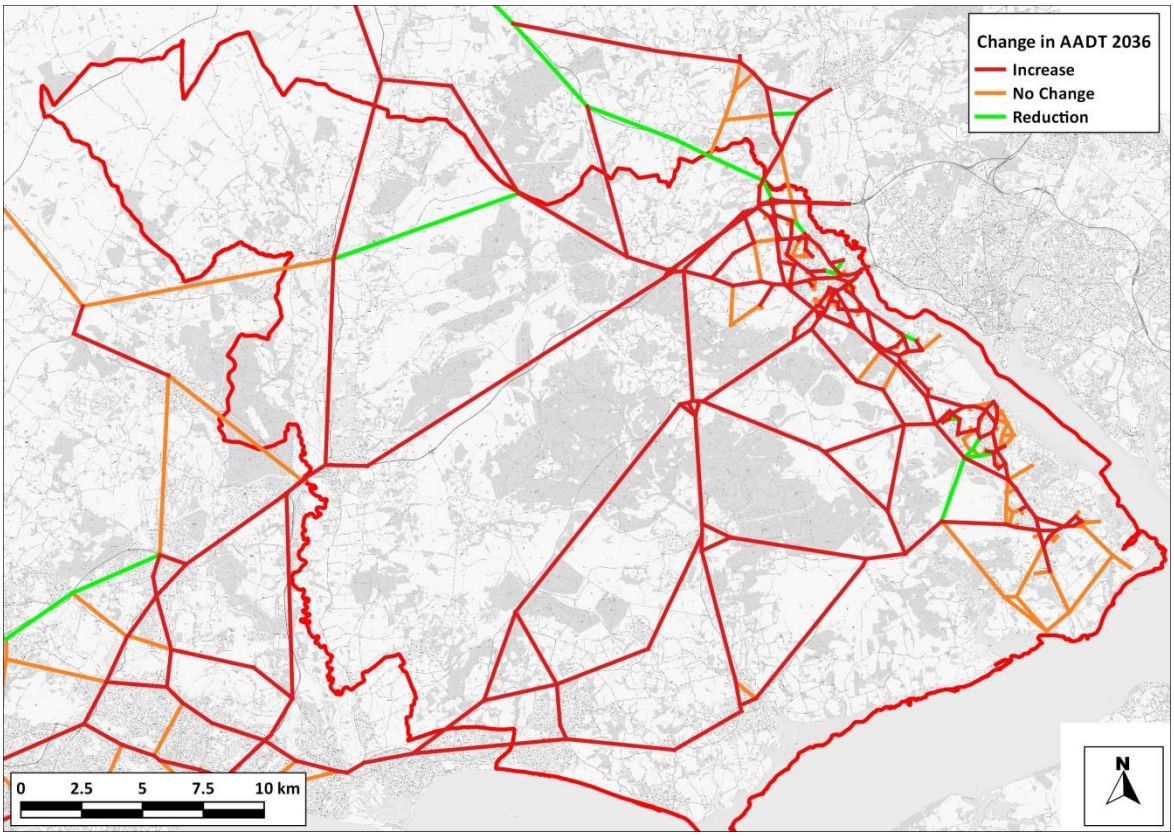


**Figure A3.2: Modelled Road Network and Changes in AADT Flows between baseline and With-Local Plan Scenarios for 2036**

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## Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A3.5 As explained in Section 3, AQC has carried out a detailed analysis which showed that, where previous standards had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the 'Euro VI' and 'Euro 6' standards are delivering real on-road improvements (AQC, 2016b). Furthermore, these improvements are expected to increase as the Euro 6 standard is fully implemented. Despite this, the detailed analysis suggested that, in addition to modelling using the EFT (V7.0), a sensitivity test using elevated nitrogen oxides emissions from certain diesel vehicles should be carried out (AQC, 2016b). A worst-case sensitivity test has thus been carried out by applying the adjustments set out in Table A3.1 to the emission factors used within the EFT[6], using AQC's CURED (V2A) tool (AQC, 2016a). The justifications for these adjustments are given in AQC (2016b). Results are thus presented for two scenarios: first the 'official prediction', which uses the EFT with no adjustment, and second the 'worst-case sensitivity test', which applies the adjustments set out in Table A3.1. The results from this sensitivity test are likely to over-predict

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

emissions from vehicles in the future and thus provide a reasonable worst-case upper-bound to the assessment.

**Table A3.1: Summary of Adjustments Made to Defra's EFT (V7.0)**

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

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

## Background Concentrations

A3.6 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2017c). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030. The background maps for 2015 have been calibrated against concurrent measurements from national monitoring sites. The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted concentrations for the future assessment year than those derived from the Defra maps (AQC, 2016c).

### *Background $NO_2$ Concentrations for Sensitivity Test*

A3.7 The road-traffic components of nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2016c).

## Model Verification

A3.8 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

A3.9 Most nitrogen dioxide ($NO_2$) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of NOx ($NO_x$ = NO + $NO_2$). The model has been run to predict the annual mean NOx concentrations during 2015 at all modelling sites within Lyndhurst, as well as at Site 32 (adjacent to the A31), Site 34 (adjacent to Normandy Way) and Site 36 (adjacent to Marchwood By-pass). Where it has been possible to locate the monitoring site, concentrations have been modelled at a height deemed reasonable by judgement. At locations where it has not been possible to locate the

monitoring site, the height provided in the 2016 Annual Status Report has been used for that monitor.

A3.10 The model output of road-$NO_x$ (i.e. the component of total $NO_x$ coming from road traffic) has been compared with the 'measured' road-$NO_x$. Measured road-$NO_x$ has been calculated from the measured $NO_2$ concentration and the predicted background $NO_2$ concentration using the $NO_x$ from $NO_2$ calculator (Version 5.1) available on the Defra LAQM Support website (Defra, 2017a).

A3.11 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.4). The calculated adjustment factor of 2.9141 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A3.12 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background $NO_2$ concentration within the NOx to $NO_2$ calculator. Figure A3.4 compares final adjusted modelled total $NO_2$ at each of the monitoring sites to measured total $NO_2$, and shows a close agreement.

A3.13 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

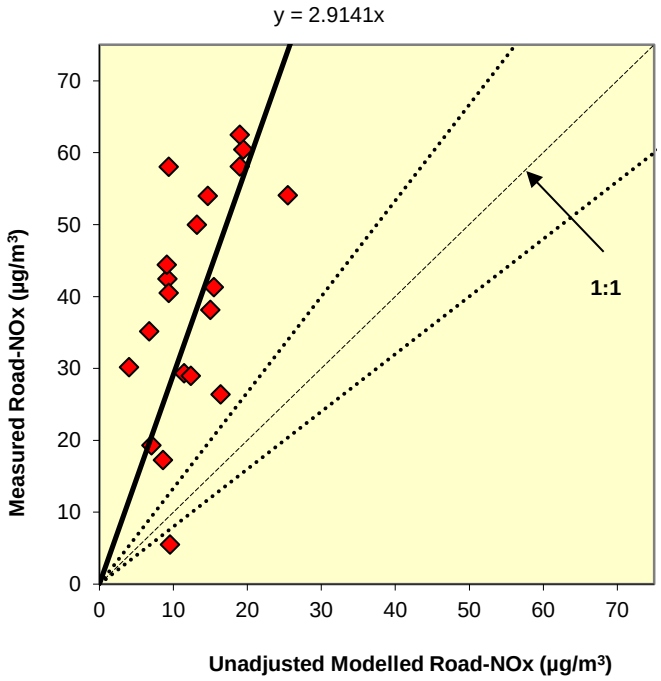


**Figure A3.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.**

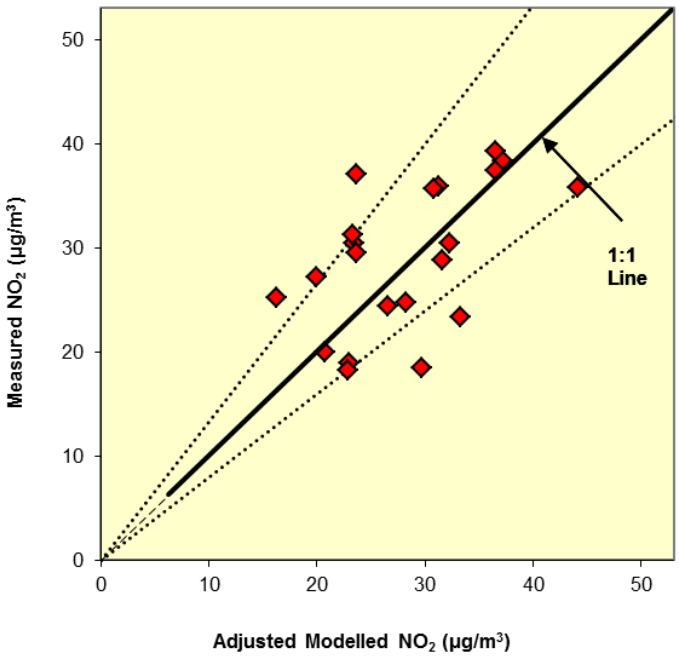


**Figure A3.4: Comparison of Measured Total $NO_2$ to Final Adjusted Modelled Total $NO_2$ Concentrations. The dashed lines show ± 25%.**

### *Model Verification for $NO_x$ and $NO_2$ Sensitivity Test*

A3.14 The approach set out above has been repeated using the predicted road- $NO_x$ specific to the sensitivity test. This has resulted in an adjustment factor of 2.6616, this implies that the unadjusted model is under-predicting the road-$NO_x$ contribution.

### *Verification Site Locations*

A3.15 Monitoring carried out by New Forest District Council is concentrated in the towns of Lyndhurst and Totton. The High Street, the main road through Lyndhurst, and along which the majority of monitoring locations used in the verification are situated, exhibits canyon like features, formed by tall buildings on either side of the narrow road, where vehicle speeds are likely to be slow from congestion. Monitoring site 32, located at Stoney Cross, is adjacent to the A31 where vehicle flows will be less congested and dispersion will occur more freely, however, the site is 20 m from the roadside. Sites 34 and 36 are also set back from the roadside; however the adjacent roads will carry faster moving traffic, in a better environment for dispersion, than those in Lyndhurst. Despite these differences in setting, there is no observed systematic difference between the performance of the model in these urban and non-urban settings. It is thus considered appropriate to verify the model against a combination of sites in Lyndhurst and those beside free-flowing roads. A model is considered to be performing well if the majority of predictions are within ±25% of the

measurement (the dotted lines in Figure A3.4). Whilst there are several points outside of the 25% banding, there is no defensible reason, such as local phenomena influencing local concentrations, to remove these from the verification process.

A3.16 Despite a root mean square error of 6.5 µg/m$^3$ (4 µg/m$^3$ is recommended in LAQM TG16), considering the available monitoring locations, it is not thought that iterations to the model setup; which would principally involve the roads in urban areas, would improve the model verification, and therefore no further iterations to the model were completed.

### *$PM_{10}$ and $PM_{2.5}$*

A3.17 The model outputs of road-$PM_{10}$ and road-$PM_{2.5}$ have been adjusted by applying the adjustment factor calculated for road NOx.

## Model Post-processing

### *Road Traffic*

A3.18 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background $NO_2$, has been processed through the NOx to $NO_2$ calculator available on the Defra LAQM Support website (Defra, 2017c). The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of $NO_2$ based on the adjusted road-NOx and the background $NO_2$.