16. Air Quality

16.1. Introduction

16.1.1. This chapter presents the Stage 3 air quality assessment for the Proposed Scheme. The assessment has been carried out in accordance with the DMRB Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, May 2007 (referred to as DMRB HA207/07[i]) and relevant Interim Advice Notes (IANs) as listed in the Legislation, Policy and Guidance section (see Section 16.2).

16.1.2. There is the potential for air quality impacts to arise during both the construction and operational phases of the Proposed Scheme.

16.1.3. During the construction phase, dust and particulate matter emissions may be generated by on-site construction activities; minor, temporary increases in concentrations of air pollutants may occur due to emissions from construction vehicles and plant. The assessment has identified residential and other sensitive receptors that could be at risk, the construction activities to be carried out and their duration. Appropriate mitigation is identified.

16.1.4. Once operational, changes in traffic flows, speeds and composition associated with the Proposed Scheme may result in changes in concentrations of air pollutants at sensitive receptors, both in the vicinity of the Proposed Scheme itself and adjacent to affected roads. The operational assessment includes: the definition of the air quality assessment study area; review of the existing baseline conditions and constraints; the determination of impacts on local air quality and regional emissions, and interpretation of significance.

16.1.5. The local air quality assessment has focused on the impacts of the air pollutants nitrogen dioxide (NO_2) and particulate matter (PM) as the air quality criteria for these two pollutants are likely to be most difficult to achieve in the vicinity of roads. The regional assessment of emissions considers oxides of nitrogen (NO_x), carbon dioxide (CO_2) and particulate matter.

Study Area

16.1.6. The air quality study area has been defined based on changes in traffic data as a result of the Proposed Scheme (i.e. the “with Proposed Scheme” or Do-Something [DS] scenario compared to the “without Proposed Scheme” or Do-Minimum [DM] scenario) in the opening year of 2026. The air quality study area has been determined in accordance with traffic change criteria set out in DMRB HA207/07 which defines affected road networks (ARN) for local (paragraph 3.12) and regional (paragraph 3.20) air quality assessments.

16.1.7. The ARN for the purposes of a local air quality assessment is defined as those roads within a defined ‘traffic reliability area’ (i.e. the area of the traffic model considered to provide reliable estimates of traffic when the base traffic model is compared to observed traffic) that meet any of the traffic change criteria, whereby:

- road alignment will change by 5 metres (m) or more
- daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more
- heavy Duty Vehicle (HDV) flows will change by 200 AADT or more
- daily average speed will change by 10 kilometres per hour (km/hr) or more

- peak hour speed will change by 20km/hr or more

16.1.8. For the assessment of local air quality (human health and statutory ecological designated sites), the air quality study area is limited to 200m either side of each road carriageway section identified in the local air quality ARN. This distance of 200m is industry best practice specified in DMRB HA207/07, having been derived from calculations using atmospheric dispersion modelling and reviewed in a series of field measurements. In practice, all major road sources within 200m of receptors are considered, whether in the affected road network or not.

16.1.9. The ARN for the purposes of a regional air quality assessment is defined as those roads within a defined 'traffic reliability area' that meet any of the traffic change criteria, whereby:

- daily traffic flows will change by 10% AADT or more
- HDV flows will change by 10% AADT or more
- daily average speed will change by 20 km/hr or more

16.1.10. Traffic data were provided in terms of total vehicles and the percentage of heavy goods vehicles (HGV) whereas the DMRB HA207/07 change criteria, as given above, relates to change in HDV. For the purpose of this assessment, in the absence of further information on fleet composition, the HDV change criteria has been applied to the HGV data.

16.1.11. The extent of the ARN for the local air quality assessment includes the A9 mainline carriageway only, whereas the ARN for the regional assessment also includes the A9 slip roads and the adjacent B9154 (due to the use of percentage change as criteria rather than absolute vehicle numbers). The study area for the local air quality assessment (defined as the area within 200m buffer of the local air quality ARN) is shown in Figure 16.1a-f.

16.1.12. The study area for the construction dust assessment has been determined in accordance with the Institute of Air Quality Management (IAQM) 'Guidance on the assessment of dust from demolition and construction', February 2014 (IAQM Construction Dust Guidance)[ii] (referenced in Section 16.2 below and described in detail in Appendix A16.1). It comprises areas that are within 350m of the site works boundary and within 50m of roads used by construction vehicles on the public highway (assumed to be the A9), to access the site up to 500m from the site works boundary. The study area for the construction dust assessment is shown in Figure 16.2a-f.

16.2. Approach and Methods

Legislation, Policy and Guidance

16.2.1. Relevant air quality legislation, policy and guidance, including relevant Air Quality Strategy (AQS) objectives, are provided in Appendix A16.1.

16.2.2. The air quality assessment of the Proposed Scheme has been undertaken in accordance with relevant guidance outlined in DMRB HA207/07, associated IANs, Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16))[iii] and IAQM guidance. The guidance documents referred to are listed below:

- HA207/07 Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1 Air Quality, May 2007 (DMRB HA207/07)[i]

- IAN 170/12 v3 Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB HA207/07, November 2013[iv]
- IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB HA207/07, June 2013[v]
- IAN 175/13 Updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users DMRB HA207/07[vi]
- Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16))[iii], where appropriate
- IAQM Construction Dust Guidance[ii]

16.2.3. IAN 185/15 Updated traffic, air quality advice on assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB HA207/07[vii] has not been adopted by Transport Scotland, other than when the Proposed Scheme passes through an Air Quality Management Area (AQMA). As detailed in Section 16.3 of this chapter there are no AQMA in the vicinity of the Proposed Scheme and therefore IAN 185/15 has not be used for the assessment.

Baseline Data Collection

16.2.4. Information on existing baseline air quality conditions within the study area was obtained from the following sources:

- The Highland Council's air quality review and assessment reports[viii]
- air quality background concentrations, monitoring data, emissions data and Pollution Climate Mapping (PCM) baseline modelling data acquired from the Scottish Environment Protection Agency (SEPA)[ix], Defra's UK Air Quality Information Resource (UK-AIR)[x] and The Highland Council
- designated ecological site information from Magic GIS[xi] and Scottish Natural Heritage (SNH) Information Service[xii]

Impact Assessment

Construction Phase

16.2.5. Construction impacts have been considered in qualitative terms, in accordance with industry accepted practice within the IAQM Construction Dust Guidance. Detailed methodology for the assessment is provided in Appendix A16.1.

Operation Phase

16.2.6. The air quality assessment consists of:

- determination of the air quality study area
- discussion of existing baseline conditions
- assessment of the likely changes in local air pollutant concentrations during operation and their significance
- assessment of the likely changes in regional air pollutant emissions during operation

16.2.7. For the assessment of operational impacts, DMRB HA207/07 and relevant IANs provide methodologies for undertaking simple and detailed levels of assessment. A simple level of assessment of the local air quality impacts has been undertaken using the DMRB air

quality screening tool methodology detailed in Annex D of DMRB HA207/07. The potential effects on NO_2, PM_{10} and $PM_{2.5}$ (defined in Appendix A16.1) concentrations at human health receptors, and NO_x and nitrogen deposition at designated ecological sites in the opening year, has been determined. The total concentrations have been estimated and compared with the AQS objective for these pollutants, to indicate whether the Proposed Scheme results in any new exceedances of AQS objective or worsening of existing exceedances. A simple level of assessment has also been undertaken for regional emissions for the opening and design years.

16.2.8. Traffic data were provided for a base year (2016), to allow verification of the air quality model against scheme specific monitoring, and the first full year of operation (2026).

16.2.9. For assessment of impacts on local air quality, four scenarios were modelled:

- base year (2016)
- projected base year (2026)
- first full year of operation Do-Minimum (2026)
- first full year of operation Do-Something (2026)

16.2.10. For assessment of impacts on regional emissions assessment scenarios the design year is also included:

- base year (2016)
- first full year of operation Do-Minimum (2026)
- first full year of operation Do-Something (2026)
- design year Do-Minimum (2041)
- design year Do-Something (2041)

Local Air Quality Assessment

16.2.11. The assessment of the potential air quality impacts of the Proposed Scheme has been undertaken using the simple assessment method detailed in Annex D of DMRB HA207/07. The method consists of a spreadsheet-based approach to modelling pollutant concentrations at receptor locations.

16.2.12. The DMRB spreadsheet does not contain the most up-to-date version of Defra's Emissions Factors Toolkit (EFT, version 7.0, August 2016)[xiii]. The contribution, in $\mu g/m^3$ (atmospheric concentration) per g/km/hr (emission), of the traffic on each modelled link to pollutant concentrations at receptors has therefore been calculated using the dispersion equations stated in DMRB HA207/07 Annex C3.2 in combination with the latest EFT values. The emission calculations assumed a "Motorway – Not London" road type for all modelled A9 links and "Rural – Not London" for all other roads.

16.2.13. The DMRB model estimates the contribution from road traffic emissions to annual mean concentrations of pollutants at discrete receptors; these concentrations were then combined with estimates of background concentrations (taken from the Air Quality in Scotland background maps for the relevant assessment year), to derive total annual mean concentrations. More detail on the background concentrations used in the modelling is provided in Section 16.3.

16.2.14. Total annual mean NO_2 concentrations were calculated from estimated road NO_x and background NO_2 concentrations, using the latest version of the 'NO_x to NO_2 conversion spreadsheet' (version 5.1)[xiv] available from the Defra UK-AIR website.

16.2.15. In addition to the estimated road NO_x and background NO_2 data, Defra's NO_x to NO_2 conversion spreadsheet requires a local authority area to be specified to determine regional oxidant concentrations, and a traffic mix to determine the proportion of primary NO_2. The local authority specified in the conversion tool was "Highland"; the traffic mix selected was "All non-urban UK traffic" for all roads included in the model.

16.2.16. The assessment has been undertaken in accordance with the IAN 170/12 on future NO_x and NO_2 projections, to account for variations in future year NO_2 predictions[iv]. The consequence of the conclusions of Defra's advice on long term NO_2 trends is that there is a gap between projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality in Defra's previously published technical guidance and observed trends. Air quality assessments following Defra LAQM.TG(16) guidance are considered to be overly optimistic in some cases. IAN 170/12 requires that steps are taken to adjust the estimated total NO_2 concentrations from modelling, termed "gap analysis" in order to better reflect future trends.

16.2.17. An additional scenario (projected base year) is required to enable the gap analysis to be completed. The projected base year scenario is modelled using the base year traffic data with the opening year vehicle emission factors and opening year background concentrations. Total NO_2 concentrations for the projected base year are calculated as described above. The results for the opening year are then adjusted using gap analysis to represent the observed long term trend profile.

16.2.18. Annual mean NO_2 concentrations based on both Defra LAQM.TG(16) and IAN 170/12 gap analysis factors are presented for comparison in Appendix A16.1. Annual mean NO_2 concentrations based on IAN 170/12 have been used in the core case for determining the impacts of the Proposed Scheme on local air quality.

Calculation of Nitrogen Oxides

16.2.19. NO_x concentrations were estimated within relevant designated ecological sites up to a distance of 200 metres from the existing and new road centreline for comparison against the annual mean AQS objective of 30 µg/m^3. The assessment was carried out using the IAN 170/12 gap analysis factors and the results are presented in Appendix A16.1.

Verification

16.2.20. Model verification is the process by which uncertainties in the modelling process are investigated and, wherever possible, minimised. The verification step involves a comparison of model estimated pollutant concentrations with measured values that are representative of the base year assessment (for this assessment, 2016). Verification was undertaken in accordance with Defra Technical Guidance LAQM.TG(16).

16.2.21. A scheme specific NO_2 monitoring survey has been undertaken for the purposes of obtaining data suitable for the verification of the model findings (see Section 16.3). Survey locations are provided in Table 16.5 and details of the verification provided in Appendix A16.1.

16.2.22. Monitoring of particulate matter is not carried out within the study area; therefore the model performance for this pollutant has not been verified. This is a common position for many scheme assessments given that the road contribution of particulate matter is much smaller than that of NO_x.

Assessment Criteria

Value/Sensitivity

16.2.23. Receptors that are potentially sensitive to changes in air quality are defined in DMRB HA207/07 as residential properties, schools, hospitals and statutory designated ecological sites (containing habitats sensitive to NO_x and/or nitrogen deposition) located within 200m of the ARN.

16.2.24. The following types of designated sites are relevant (where these contain habitats or species sensitive to NO_x and/or nitrogen deposition): Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar sites.

Receptors

16.2.25. Relevant locations with public exposure (including residential, medical and educational premises if present) have been identified from Ordnance Survey MasterMap® data[xv]. The Magic GIS website and datasets available from the Scottish Natural Heritage (SNH) Information Service were used to identify relevant designated ecological sites in the vicinity of the Proposed Scheme and its ARN (SSSI, SAC, SPA and Ramsar sites).

16.2.26. There is one designated ecological site identified within the study area, at Slochd SAC (as detailed in the Baseline Section 16.3). Transects of receptor points from the closest point within the designated site and at set distances of approximately 50m, 100m, 150m and 200m from the nearest road were assessed (see Figure 16.1a). Further details of the designated ecological sites, including habitat types and applicable critical loads are provided in the Section 16.3.

16.2.27. A total of 10 discrete receptors and 10 monitoring locations (7 of which have been used for model verification) were included in the DMRB model. No relevant ecological receptors were identified within the study area (as described in Section 16.3), therefore an assessment is only required of the potential impacts on human health. The assessed receptors are listed in Table 16.1 and the designated ecological site transects are listed in Table A16.2 in Appendix A16.1. Both human health and ecological receptors are and shown on Figure 16.1a-f.

Table 16.1: Human Health Receptors

Receptor	Grid Reference	Description
1	NH27658343	Suilven, Moy Station Road, Moy
2	NH27668340	Forester's House, Lynebeg Road, Moy
3	NH27698341	Moybeg Cottage, Lynebeg Road, Moy
4	NH27708342	Fearnach, Moy
5	NH27788336	The Old Schoolhouse, Moy School Road, Moy
6	NH27878323	The Sheiling, Dalmagarry, Moy
7	NH27938307	The Bellhouse, Allt Dubhag Road, Tomatin
8	NH27958307	Gardener's Cottage, (Tigh an Allt), Tomatin
9	NH27998296	Porters Lodge, Tomatin
10	NH80892900	Dalmahoyne House, Raibeg

Magnitude of Change

16.2.28. Evaluation of the significance of the local air quality assessment findings has been undertaken in accordance with IAN 174/13, based on results using IAN 170/12 as the most likely case.

16.2.29. Descriptors for magnitude of impact due to changes in ambient concentrations of NO_2 and PM_{10} are provided in the IAN 174/13. Current DMRB assessment guidance does not require the assessment of $PM_{2.5}$, and so $PM_{2.5}$ is not addressed within IAN 174/13. As there is an annual mean objective for $PM_{2.5}$ in Scotland, criteria set out in IAN174/13 for the assessment of change to annual mean concentrations of NO_2 and PM_{10} have also been applied to $PM_{2.5}$.

16.2.30. The changes in magnitude, which are based on an assumed measure of uncertainty (MoU) of 10%, may be described as 'small', 'medium', 'large' or 'imperceptible', depending on the change in concentration relative to the air quality criterion.

16.2.31. Table 16.2 presents magnitude of change criteria for application to annual mean pollutant concentrations. According to IAN 174/13, only those receptors that are at a reasonable risk of exceeding relevant air quality thresholds need to be considered when determining significance.

16.2.32. In line with guidance within IAN174/13, the magnitude categories within Table 16.2 have also been applied to changes in annual mean concentrations of NO_x for the assessment of designated ecological sites.

Table 16.2: Magnitude of Change Criteria for Local Air Quality

Magnitude of change in concentration	Percentage change in annual mean NO_x, NO_2, PM_{10} and $PM_{2.5}$
Large	Greater than full MoU value of 10% of the air quality objective
Medium	Greater than half of the MoU value of 5%, but less than the full MoU of 10% of the air quality objective
Small	More than 1% of objective and less than half of the MoU i.e. 5%. The full MoU is 10% of the air quality objective
Imperceptible	Less than or equal to 1% of objective

Impact Significance

16.2.33. According to IAN 174/13, only those receptors that are at a reasonable risk of exceeding relevant air quality thresholds need to be considered when determining significance. The assessment of significant air quality impacts is therefore only applied to receptors where air quality thresholds are exceeded in either the Do-Minimum (without Proposed Scheme) and/or Do-Something (with Proposed Scheme) scenarios.

16.2.34. In order to assess the significance of impacts for annual mean NO_2, PM_{10} and $PM_{2.5}$, the number of receptors that fall within the 'small', 'medium' and 'large' magnitude of change categories is calculated and compared to the guidelines presented in Table 16.3 (note, an imperceptible magnitude of change is not considered to result in a significant impact).

16.2.35. As outlined in IAN 174/13, for the determination of significance for NO_x impacts on designated ecological sites, where the difference in concentrations are less than 0.4 µg/m3 for annual average NO_x then the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance.

Table 16.3: Guideline to Number of Receptors Constituting a Significant Impact for Air Quality

Magnitude of change in concentration	Number of receptors with	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large	1 to 10	1 to 10
Medium	10 to 30	10 to 30
Small	30 to 60	30 to 60

Compliance with EU Directive on Ambient Air Quality

16.2.36. An assessment of whether the Proposed Scheme may impact on the risk of non-compliance with the EU Directive on ambient air quality is required in accordance with IAN 175/13.

16.2.37. PCM model link data were obtained from Defra's UK Ambient Air Quality Interactive Map for the Proposed Scheme air quality study area. The PCM model link data were overlaid with the Proposed Scheme local air quality ARN to determine the Compliance Risk Road Network (CRRN).

16.2.38. There are no PCM model links within the study area and therefore no assessment of compliance risk can be undertaken. This is in accordance with IAN 175/13, which states that "where the two road networks intersect, only this subset of the road network should be used to inform the compliance risk". No further assessment is therefore required as it can be concluded that there is no risk of the Proposed Scheme being non-compliant with the EU Directive on ambient air quality.

Regional Emissions Assessment

16.2.39. A regional air quality assessment was undertaken in accordance with DMRB HA207/07 to determine the pollutant emissions for the affected road network for the base year, opening year and design year. Emission calculations were undertaken using the Defra's EFT, version 7.0, to ensure the use of the latest vehicle emissions factors.

16.2.40. The pollutants included in this assessment are CO_2, NO_x and particles (including PM_{10} and $PM_{2.5}$). Emissions of CO and hydrocarbons have not been calculated as these pollutants are no longer included in current vehicle emission factors supported by Defra and DfT.

Limitations of the Assessment

16.2.41. A simple level of assessment of the impacts on local air quality using the DMRB air quality screening tool detailed in Annex D of DMRB HA207/07 has been undertaken. The spreadsheet-based model uses a simple distance drop off calculation to estimate pollutant concentrations at receptor locations. The model has been combined with the latest emission factors and other supporting tools.

16.2.42. The model does not take meteorological conditions into account, specifically wind speed or road alignment relative to wind direction. Model verification and adjustment has however, been undertaken to minimise uncertainties in the modelling and correct for bias in the calculation. Given the extremely low background concentrations in the study area and lack of PCM model links above the air quality limit values, this is considered to be a proportionate approach relative to the risk.

16.3. Baseline Conditions

Local Air Quality Management

16.3.1. The Proposed Scheme lies within the administrative boundaries of The Highland Council. The Highland Council has declared one AQMA within Inverness city centre due to exceedances of the NO_2 annual mean AQS objective. The AQMA incorporates two properties and is located approximately 11.5 km to the northwest of the Proposed Scheme. It is not expected to be affected by changes in traffic associated with the Proposed Scheme or its ARN.

16.3.2. The 2015 Updating and Screening Assessment Report concluded that no other exceedances of the relevant AQS objectives were identified at the remaining monitoring locations within The Highland Council area.

Air Quality Monitoring

16.3.3. Measurements of pollutant concentrations can be made by establishing analytical instruments that can measure across a continuous time frame and record average, minimum and maximum concentrations over specified periods.

16.3.4. Simpler sampling equipment, such as passive diffusion tubes, absorb pollutants over a longer time period and are subsequently analysed at an accredited laboratory to give an average concentration over the course of the monitoring term. Survey results from continuous monitoring are made available on UK-AIR and the Air Quality in Scotland website[xvi] whereas results from local passive monitoring are available through The Highland Council.

16.3.5. There is no ongoing continuous or passive monitoring undertaken by the local authorities in the immediate vicinity of the Proposed Scheme and its ARN.

16.3.6. The closest continuous monitoring location relative to the Proposed Scheme is at Telford Street, Inverness. The continuous monitoring station is classified as a roadside site and is within Inverness city centre, approximately 12.1 km to the northwest of the Proposed Scheme. The site is included within the UK Automatic Urban and Rural Network (AURN). The most recent monitoring data for the site, taken from The Highland Council 2015 Updating and Screening Assessment Report and the Air Quality in Scotland website are presented in Table 16.4 below for NO_2, PM_{10} and $PM_{2.5}$. A new continuous monitoring station located in Queensgate, within the AQMA was installed in September 2016, however data for the site is not yet available.

Table 16.4: Continuous Monitoring Results from Telford Street, Inverness (µg/m³)

Pollutant	2010	2011	2012	2013	2014	2015	2016
Annual mean concentration							
Nitrogen Dioxide (NO_2)	24.5^	27.0	29.2	21.0	21.0	27.5*	24
Annual Mean Objective	40 µg/m³						
Particulate Matter (PM_{10})	14.0	11.8	11.0	11.7	11.0	9.0	n/a
Annual Mean Objective	18 µg/m³						

Pollutant	2010	2011	2012	2013	2014	2015	2016
Annual mean concentration							
Particulate Matter ($PM_{2.5}$)	7.0	6.0	6.0	6.0	6.0	5.0	n/a
Annual Mean Objective	10 µg/m^3						
^ Data capture <90% * Data taken from Defra UK-AIR. Data capture rate <75% therefore not reliable.							
Short term mean concentrations (exceedances of the standard)							
Nitrogen Dioxide (NO_2)	0	0 (118)	0	0	0	0	n/a
Hourly Mean Objective	200 µg/m^3 not to be exceeded more than 18 times per year						
Particulate Matter (PM_{10})	0	2 (24.9)	0 (20.0)	1	0	0	n/a
Daily Mean Objective	50 µg/m^3 not to be exceeded more than 7 times per year						
Where the data capture was less than 90% the relevant percentile displayed in brackets							

16.3.7. Given the urban location of the Telford Street monitoring site, data are not considered representative of the Proposed Scheme study area, which is predominantly rural. However, as NO_2 and PM_{10} concentrations are below the annual mean and short term AQS objectives at the city centre site, it is reasonable to assume that pollutant concentrations within the Proposed Scheme study area are below the respective AQS objectives. This is further supported by additional data including the very low Defra mapped background concentrations in the vicinity of the Proposed Scheme, and the results of the scheme specific monitoring survey which are further discussed below.

16.3.8. With respect to $PM_{2.5}$, the annual mean concentration measured at Telford Street was 7µg/m^3 in 2010 with concentrations reducing to 5µg/m^3 in 2015. These concentrations are less than the annual mean AQS objective to be achieved by 2020 in Scotland.

Scheme Specific Baseline Monitoring

16.3.9. DMRB HA207/07 requires the consideration of whether there is sufficient existing monitoring data to assess the impact of the Proposed Scheme against a baseline. At present, no existing permanent monitoring is undertaken within 200m of the Proposed Scheme or within 1km of the local air quality study area.

16.3.10. DMRB HA207/07 recommends that if there are insufficient monitoring data within the study area, passive diffusion tubes for NO_2 should be deployed as a minimum. The monitoring of air quality using diffusion tubes is recommended (within Defra LAQM.TG16[xvii]) to be carried out for at least six months to allow for seasonal variability.

16.3.11. As such, a six month baseline air quality monitoring survey commenced on 20th November 2015 and ended on 25th May 2016. The diffusion tubes used in the survey were the same type as used by The Highland Council, i.e. 20% TEA (triethanolamine) in water, supplied by Gradko Ltd, in order to ensure consistency between results.

16.3.12. Results from the six month baseline monitoring survey were annualised using data from three background AURN monitoring sites (Aberdeen, Dundee and Fort William), in accordance with Defra guidance within LAQM.TG16. Following annualisation, the

baseline monitoring survey results were bias corrected by applying the national bias adjustment factor obtained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet[xviii] (a database of bias adjustment factors determined from local authority co-location studies throughout the UK).

16.3.13. Monitoring locations are shown on Figure 16.1a-f. Details and annualised mean concentrations for 2015 for each location are presented in Table 16.5. Details of the annualisation process are provided in Table A16.6 in Appendix A16.1. The adjusted, annualised concentrations at all the diffusion tube sites were below the air quality criterion for NO_2.

Table 16.5: Scheme Specific NO_2 Monitoring Locations and 2015 Annual Mean

ID	Grid Reference	Height	Site Type	Description	2015 Annual Mean ($\mu g/m^3$)
TM01	NH7841332572	2.3	Background	Former telephone exchange building, Dalmagarry, 30m from A9 (embankment)	7.3
TM02	NH7469537956	2.5	Background	Meallmore Lodge Nursing Home, B9154 lay-by	2.5
TM03	NH7660734470	2.8	Roadside	B9154 lay-by at Old Inn, Moy	3.7
TM04	NH7695634087	2.5	Background	Moybeg Cottage entrance, B9154 / A9, Moy	5.3
TM05	NH7780033517	2.6	Roadside	Old School House, B9154	6.4
TM06	NH7872832163	2.8	Background	Cyclepath off A9 at Dalmagarry	4.8
TM07	NH7946130388	2.7	Roadside	Lay-by 160 sign, off A9 at Tomatin	7.8
TM08	NH7932830648	3.1	Background	Lay-by off A9 at Inverbrough	6.0
TM09	NH7988229608	2.8	Kerbside	Sandside, C1121	4.4
TM10	NH8026029084	2.8	Kerbside	Railway viaduct, C1121, Tomatin	3.1

16.3.14. Analysis of data for the three background AURN monitoring sites used for annualisation along with data from the Inverness roadside site found no statistically significant trend in annual mean NO_2 concentrations between 2012 and 2016. The 2015 monitoring data was therefore used without adjustment to verify the 2016 base year air quality modelling. The monitored annual mean NO_2 concentrations at Inverness, Aberdeen, Dundee and Fort William background AURN, used in the analysis, are presented for reference in Appendix A16.1, Table 16.8.

Emission Sources

16.3.15. The UK National Atmospheric Emissions Inventory (NAEI) provides source sector emissions data by 1km squares for local authorities[xix]. To provide context to the study area, NO_x and PM_{10} emissions by source sector are presented in Table 16.6 for an average of the grid squares in which the Proposed Scheme is located, between Tomatin and Moy. Emissions of NO_x and PM_{10} are primarily attributable to road transport (around two thirds of total).

Table 16.6: Emissions of Air Pollutants in 2014 (tonnes) from Different Sectors

Source Sector	NO_x (tonnes)	NO_x % of total	PM_{10} (tonnes)	PM_{10} % of total
01 – Combustion in energy production and transfer	<0.01	<0.1%	0.16	5.2%
02 – Combustion in commercial, institutions, residential and agricultural sectors	0.45	1.1%	0.89	28.3%
03 – Combustion in industry	5.76	14.1%	<0.01	0.1%
04 – Production processes	<0.01	<0.1%	<0.01	<0.1%
05 – Extraction / Distribution of Fossil Fuels	N/A	N/A	N/A	N/A
06 – Solvent Use	N/A	N/A	0	<0.1%
07 – Road transport	28.67	69.9%	1.97	62.9%
08 – Other transport and machinery	6.08	14.8%	0.027	0.9%
09 – Waste treatment and disposal	<0.01	<0.1%	<0.01	<0.1%
10 – Agricultural, forests and land use change	N/A	N/A	0.05	1.7%
11 – Other sources and sinks	0.04	0.1%	0.03	0.8%

Ecological Designations

16.3.16. The Defra Magic website and the SNH Information Service GIS datasets were used to identify statutory designated ecological sites in the vicinity of the Proposed Scheme such as SSSI, SAC, SPA and Ramsar sites.

16.3.17. Designated ecological sites need only be considered in terms of air quality where they are located within 200m of the Proposed Scheme or ARN. There is one designated site of international importance (Slochd SAC) within 200m of the Proposed Scheme and ARN. The SAC (shown on Figure 16.1a) contains habitats sensitive to NO_x and nitrogen deposition. Critical loads for nitrogen deposition are available from the APIS website. The recommended UNECE critical loads for the main habitat type have been selected. The critical loads for nitrogen deposition along with background nitrogen deposition and NO_x at the designated ecological sites considered in the assessment are shown in Table 16.7 below.

Table 16.7: Critical Loads for Nutrient Nitrogen and Background Nitrogen Deposition

Designated Site	Habitat Type or Species	Critical Load (kg N ha^{-1} yr^{-1})	Average Background Nitrogen Deposition (kg N ha^{-1} yr^{-1})^	2016 Average Background NO_x ($\mu g/m^3$)
Slochd SAC	European dry heaths	10-20	5.2	2.8
^The background nitrogen deposition rate was taken from the APIS website (based on a 3-year mean for 2012-14).				

Background Concentrations

16.3.18. Background maps are provided by the Air Quality in Scotland website[xx] to assist local authorities in support of the review and assessment of local air quality[xxi]. These provide background concentrations of NO_x, NO_2, and PM_{10}. Mapped background concentrations

of each pollutant can be downloaded for each 1km by 1km grid square in Scotland and are modelled based on monitoring and meteorological data for the year 2013 and projected for future years to 2030.

16.3.19. For $PM_{2.5}$, concentrations were estimated by applying the ratio of Defra mapped background concentrations[xxii] of PM_{10} to $PM_{2.5}$ to the Scottish background mapping of PM_{10}, as background mapping is not currently available for $PM_{2.5}$ from the Air Quality in Scotland website. The scaling factor applied to the annual mean PM_{10} concentrations to estimate annual mean $PM_{2.5}$ concentrations is unique to each grid square, with factors applied across the study area ranging between 0.71 and 0.75.

16.3.20. The mapped background concentrations were adjusted to remove Trunk A-Road and Primary A-Road contributions to the total mapped concentrations in each grid square. This is undertaken to avoid double counting, in accordance with Defra guidance using the background sector removal tool[xxiii]. This tool was developed for use with the Defra mapped background concentrations and does not work correctly with the background maps available from the Air Quality in Scotland website, given the low background values found in the study area. The adjusted NO_x and NO_2 mapped background concentrations used in the assessment have therefore been taken from the Defra datasets. Defra mapped background NO_2 concentrations are slightly higher (between 7 and 15%) than those in the Air Quality in Scotland dataset and therefore provide a more conservative assessment.

16.3.21. Maximum, minimum and average adjusted background concentrations for the study area for the years 2016 (base year) and 2026 (opening year) are given in Tables 16.8 and 16.9 for NO_x, NO_2, PM_{10} and $PM_{2.5}$. Unadjusted background concentrations are also provided for comparison. The study area comprises 21 grid squares from the northern most grid square 272500, 835500 to southern most grid square 281500, 827500.

Table 16.8: 2016 Annual Mean Background Concentrations (µg/m^3)

	Unadjusted				Adjusted (with sector removal)			
	NO_x	NO_2	PM_{10}	$PM_{2.5}$	NO_x	NO_2	PM_{10}	$PM_{2.5}$
Minimum	2.4	1.9	6.1	4.5	2.2	1.7	6.1	4.5
Maximum	3.3	2.6	7.0	5.3	2.4	1.9	7.0	5.2
Average	3.0	2.4	6.5	4.7	2.3	1.8	6.4	4.7

Table 16.9: 2026 Annual Mean Background Concentrations (µg/m^3)

	Unadjusted				Adjusted (with sector removal)			
	NO_x	NO_2	PM_{10}	$PM_{2.5}$	NO_x	NO_2	PM_{10}	$PM_{2.5}$
Minimum	1.7	1.4	5.9	4.3	1.6	1.3	5.9	4.3
Maximum	2.1	1.7	6.8	5.1	1.8	1.4	6.8	5.1
Average	2.0	1.6	6.3	4.5	1.7	1.4	6.3	4.5

16.3.22. The mapped background concentrations shown above are well below the annual mean AQS objectives (presented in Appendix A16.1 Table 16.1) for all pollutants in both years.

16.3.23. The 2016 Defra background mapped concentrations were compared with the monitoring survey result for the background monitoring site TM02. The comparison is presented in Appendix A16.1 Table 16.7. The measured results are within 19% of the mapped background for the grid square containing the monitoring site. It is therefore considered

appropriate (in line with LAQM.TG16) to use the mapped background estimates to characterise background air quality conditions in the study area in 2016 and 2026.

16.3.24. Mapped and measured concentrations at background locations in the vicinity of the ARN suggest that that air quality in the immediate vicinity of the ARN is likely to be very good. Results from the scheme specific air quality survey show that the concentrations at properties in the immediate vicinity of the Proposed Scheme are less than a quarter of the AQS objectives.

16.4. Potential Impacts

Construction

16.4.1. The IAQM Construction Dust Guidance begins with a screening stage to determine the potential for construction dust impacts. This was carried out by determining the number and type of sensitive receptors within relevant distances of the site boundary and haul route, using Ordnance Survey MasterMap® data[xv].

16.4.2. Figure 16.2a-f shows a 350m buffer around the site boundary and a 50m buffer around routes likely to be used by construction vehicles accessing and egressing the site up to 500m from the assumed Site entrances.

16.4.3. There are a number of 'human receptors' within 350m of the site boundary. These include residential dwellings, places of work and places of worship located in:

- Moy (Lynebeg Road and Moy Station Road)
- Tomatin (Allt Dubhag Road, Station Road, Distillery Access Road and Freeburn)
- Raigbeg
- Soilsean
- Dalmagarry

16.4.4. There are no other human receptors considered highly sensitive to dust such as schools or hospitals within 350m of the Site boundary.

16.4.5. There are no sensitive human receptors within 50m of the likely haul roads (assumed to be the A9), therefore trackout has not been considered further.

16.4.6. There are no relevant designated ecological sites within 50m of the site boundary or construction vehicle route, hence they are not considered further.

Dust Assessment

16.4.7. Having established the requirement for assessment, the dust emission magnitudes for the four IAQM activity categories, demolition, earthworks, construction and trackout, were determined. Where detailed information was not available, a precautionary approach was taken. It should also be noted this is a worst case assessment in that it is conservatively assumed all construction occurs at once while in practice it will be phased.

16.4.8. The estimated volume of reinforced concrete structures to be demolished as a result of the scheme is 2,700m^3, well below the suggested threshold value (20,000m^3) in the IAQM Construction Dust Guidance. These are expected to be less than 10m above ground level, therefore, although involving a potentially dusty material, the dust emission magnitude for demolition is defined as 'small'.

16.4.9. Earthworks activities associated with the Proposed Scheme may include excavating of vegetation/soils/rock, haulage, tipping and stockpiling as part of the landscaping and levelling of land. The majority of the construction area (> 10,000m^2), will require some form of earthworks). The peak offsite HDV (>3.5 tonne) movements are expected to be greater than 50 movements per day. The earthworks dust emission magnitude is therefore classified as 'large'. This is a precautionary approach as it uses the entire area of earthworks whereas that which could affect an individual receptor will be much smaller.

16.4.10. As the construction area measures approximately 1.4km^2, the associated dust emission magnitude for construction is also classified as 'large'. This is again a precautionary approach as the area relevant to an individual receptor will be much smaller.

16.4.11. The dust emission magnitude derived for each activity is summarised in Table 16.10

Table 16.10: Dust Emission Magnitude for the Proposed Development

Activity	Dust Emission Magnitude
Demolition	Small
Earthworks	Large
Construction	Large

16.4.12. The sensitivity of the surrounding area to potential dust soiling and human health impacts takes into account the:

- sensitivity of receptors
- distance to dust source
- background PM_{10} concentrations
- number of affected receptors

16.4.13. The majority of human receptors identified in Section 16.4.3 are classed as highly sensitive to both dust soiling impacts and health impacts of dust emissions.

16.4.14. As there between 1 and 10 highly sensitive receptors within 20m of the site boundary, the sensitivity of the surrounding area to dust soiling is classed as 'medium' for demolition, earthworks and construction.

16.4.15. As background PM_{10} concentrations, taken from DEFRA background maps, are expected to be below 14 µg/m^3 during construction and again there are between 1 and 10 highly sensitive receptors within 20m of the site boundary, the sensitivity of the surrounding area to human health impacts is classed as 'low' for these activities.

16.4.16. The area sensitivity is summarised in Table 16.11.

Table 16.11: Sensitivity of the Surrounding Area

Potential Impact	Demolition	Earthworks	Construction
Dust Soiling	Medium	Medium	Medium
Human Health	Low	Low	Low

16.4.17. Table 16.12 presents a summary of the overall dust risks associated with each activity before mitigation measures are applied. There is a 'medium' risk of dust soiling impacts and a 'low' risk of human health effects.

Table 16.12: Summary of Risk of Dust and Human Health Impacts

Potential Impact	Demolition	Earthworks	Construction
Dust Soiling	Low Risk	Medium Risk	Medium Risk
Human Health	Negligible	Low Risk	Low Risk

16.4.18. Taking the highest risk rating for the potential impacts identified, as suggested by the IAQM guidance, mitigation measures for a 'medium' risk construction site are deemed appropriate to manage potential dust impacts on the surrounding area for all construction activities. It should be noted this is a worst case assessment that conservatively assumes all construction occurs at the same time along the whole route. Instead, activities will likely be phased although no details are available at present. It is recommended that the conclusion is verified once more detailed information is available and mitigation measures commensurate with the risk are applied.

16.4.19. It is anticipated that with the implementation of effective site-specific mitigation measures the effect of emissions associated with dust raising activities will not be significant.

Construction Emissions

16.4.20. There may be a temporary increase in local air pollutant concentrations in the vicinity of the Site, due to exhaust emissions from plant used on the construction site. Typical plant could include excavators of various sizes for cutting and filling operations, piling rigs, bulldozers, and pavers and rollers for laying the road surface and compacting. The emissions temporarily generated by such plant are likely to be substantially less than those generated by traffic on the roads in the area. They are therefore not considered to have the potential to result in a significant impact on local air quality. No significant impact is therefore predicted.

16.4.21. In the UK, the Non-Road Mobile Machinery (Emission of Gaseous and Particulate Pollutants) Regulations 1999, as amended, govern emissions produced by engines fitted in construction plant.

16.4.22. Changes in vehicle emissions due to construction traffic movements and any temporary traffic diversions are not considered to have the potential to result in a significant impact on local air quality because:

- the current background concentrations surrounding the Proposed Scheme are well within the respective AQS objectives
- the number of construction vehicles likely to be attending the site during the construction period (averaged over an annual period) is relatively small in relation to existing annual average daily HGV flows on the A9

Operation

Local Air Quality

16.4.23. Verification of the 2016 base model has been undertaken through a comparison of modelled concentrations against the measured values at seven monitoring sites in the study area (see Table A16.10 and Figures A16.1 and A16.2 in Appendix A16.1). Model adjustment factors were derived for two domains; those locations within 100 m of the A9 and all those further than 100m from the A9. The adjusted model gives a sufficiently improved overall performance that can be deemed satisfactory in accordance with LAQM.TG(16).

16.4.24. The estimated road contributions to concentrations at receptors have been combined with background concentrations to derive estimates of total annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$. The results have been compared with relevant air quality thresholds to determine whether there are likely to be any exceedances of relevant AQS objectives. Annual mean NO_2 concentrations used in the core case are based on the IAN 170/12 gap analysis situation. The significance of changes in concentrations has been evaluated in line with IAN 174/13. Results are presented in detail in Appendix A16.1 - Table A16.13 to Table A16.15.

16.4.25. There are no exceedances of the NO_2, PM_{10} or $PM_{2.5}$ AQS objectives at any receptor in the base or opening year with and without the Proposed Scheme.

16.4.26. As concentrations at all receptors are below the AQS objectives in all scenarios, in accordance with IAN 174/13, the impact on local air quality is assessed as 'not significant'.

Designated Ecological Sites

16.4.27. The assessment has shown that there are no exceedances of the annual mean NO_x AQS objective of 30µg/m^3 for the protection of vegetation in the base or opening year with and without the Proposed Scheme at locations closest to the road at Slochd SAC. In accordance with IAN 174/13, the impact on designated ecological sites can be assessed as **Not Significant**. The annual mean NO_x results for all modelled ecological receptors are presented in detail in Appendix A16.1 (Table A16.17).

Regional Emissions

16.4.28. Emissions from roads included in the regional air quality assessment study area have been estimated for CO_2, NO_x, PM_{10} and $PM_{2.5}$ in the base year (2016) and with and without the Proposed Scheme in both the opening year (2026) and the design year (2041). The results are presented in Appendix A16.1 (Table A16.16) and are discussed below.

16.4.29. In 2026, the changes in regional air pollutant emissions due to the Proposed Scheme are expected to result in an increase of between 17% and 40% when compared to the Do Minimum scenario. This is due to an expected 20% increase in vehicle kilometres travelled in the Do-Something scenario.

16.4.30. By 2041, the Proposed Scheme is expected to result in an increase in emissions of all pollutants by between 15% and 37%, compared to the equivalent Do Minimum. This again due to the 18% increase in vehicle kilometres travelled.

16.4.31. When compared to the 2016 base year, emissions of NO_x reduce across all scenarios. Emissions for both PM_{10} and $PM_{2.5}$ in the Do Minimum opening year are reduced when compared with the base year, however only $PM_{2.5}$ reduces in 2041 when compared to the base.

16.4.32. For the greenhouse gas CO_2, increases from the 2016 base year are calculated for all scenarios. Whilst the magnitude of change relative to the 2016 base year may appear substantial, in terms of mass emissions the change due to the Proposed Scheme can be considered small within the context of national emissions (presented in Appendix A16.1. The change in CO_2 emissions with the scheme represents approximately 0.01% of the total reported national emissions of CO_2 in 2013[xxiv]).

16.5. Potential Mitigation

Mitigation during Construction

16.5.1. Mitigation measures to control dust during construction will be specified within contract documentation and incorporated into a Construction Environmental Management Plan (CEMP), which would be prepared by the Contractor in advance of any construction works. Suitable mitigation measures to be employed for a 'medium' risk category site have been identified from the IAQM Dust Guidance. These mitigation measures are applied more generally in the Chapter 21 (Schedule of Environmental Commitments) including general standard construction mitigation items SMC-S1, SMC-S2 and SMC-S3 as well as standard air quality items SMC-AQ1, SMC-AQ2 and SMC-AQ3. The precise measures to be employed will depend on intended construction operations, phasing and location, and should reflect that the assessment shown is very worst case.

16.5.2. Table 16.13 details standard mitigation measures to minimise impacts as far as possible.

Table 16.13: Air Quality Mitigation

Mitigation Item	Description
SMC-AQ1	In relation to minimising fugitive dust emissions from earthworks, material storage and concrete batching the following mitigation items will be implemented: • stockpiles and mounds will be at a suitable angle of repose to prevent material slippage, will be enclosed or securely sheeted, and/or kept damped as necessary during dry weather; • the surfaces of any long-term stockpiles which give rise to a risk of dust or air pollution will be covered with appropriate sheeting or will be treated to stabilise the surfaces; • mixing of large quantities of concrete will be carried out only in enclosed or shielded areas; • all handling areas will be maintained in a dust free state as far as is practicable with sprinklers and hoses used to prevent dust escaping from the site boundaries; and • procedures will be established so that the site is regularly inspected for spillage of dusty or potentially dusty materials and any such spillage would be dealt with promptly where necessary to prevent dust nuisance.
SMC-AQ2	In relation to minimising dust from vehicle movements within the site the following mitigation items will be implemented: • the Contractor will employ appropriate measures, such as covering materials deliveries or loads entering and leaving the construction site by a fixed cover or sheeting appropriately fixed and suitable for the purposes of preventing materials and dust spillage; • where unsurfaced routes are identified as creating dust emissions during periods of dry weather, surfaces will be regularly dampened down using water bowsers; and • appropriate speed limits will be established and enforced over all unmade surfaces.
SMC-AQ3	In relation to appropriate cleaning of public roads the following mitigation items will be implemented: • the edges wheel washing facilities will be installed as required and heavy vehicles will be required to use the facilities prior to leaving the site; • subject to approval from Transport Scotland and the network operator, public roads immediately outside the site entrance will be cleaned using vacuum

Mitigation Item	Description
	sweeper brushes and other specialised road cleaning equipment as necessary to maintain an appropriate state of cleanliness; and • roads and footpaths adjacent to the proposed scheme will be cleaned, with damping if necessary.
SMC-S1	A Construction Environmental Management Plan (CEMP) will be prepared by the Contractor. The CEMP will set out how the Contractor intends to operate the construction site, including construction-related mitigation measures identified below in Tables 21.2 to 21.11. The relevant section(s) of the CEMP will be in place prior to the start of construction work. The CEMP will include, but not be limited to, subsidiary plans relating to: agricultural soils, geology and land contamination; surface water and groundwater (including a Flood Response and Pollution Incident Response Plan); ecology (including specific Species and Habitat Management Plans); landscape, cultural heritage, air quality and noise and vibration.
SMC-S2	Prior to construction an Environmental Coordinator and team of suitably qualified Environmental Clerk of Works (EnvCoW) (i.e. professionally qualified in a relevant environmental discipline) will be appointed by the Contractor. The EnvCoW(s) will report to the Environmental Coordinator and be present on site, as required, during the construction period to monitor the implementation of the mitigation measures identified and ensure that activities are carried out in such a manner to prevent or reduce impacts on the environment.
SMC-S3	Throughout the construction period the Contractor will, as required, contribute towards the overall communications strategy for the A9 Dualling Programme. As part of this the Contractor will appoint a Community Liaison Officer supported by a liaison team as necessary who will: • liaise with the following: relevant local authorities; other statutory bodies and regulatory authorities; community councils and relevant community groups; and businesses and residents in local communities affected by the construction works; • notify occupiers of nearby properties a minimum of two weeks in advance of the nature and anticipated duration of planned construction works that may affect them; • support the production of project communications such as the project website and newsletters; and • establish a dedicated freephone telephone helpline together with a dedicated email address and postal address for enquiries and complaints during the construction phase. The relevant contact numbers, email and postal addresses will as a minimum be displayed on signs around the construction site and will be published on the project website. Enquiries and complaints will be logged in a register and appropriate action will be taken in response to any complaints.

16.5.3. Ensuring the use of established good site management practices, including where appropriate the above proposed measures, should effectively control and minimise dust generation such that there will be no significant dust effects beyond the site boundary

Mitigation during Operation

16.5.4. The air quality assessment indicates that the Proposed Scheme would not result in any new exceedances of AQS objectives or worsening of existing exceedances. No air quality mitigation for the operational phase of the Proposed Scheme is therefore required.

16.6. Residual Effects

16.6.1. Construction dust impacts will be managed through the application of suitable mitigation and management techniques commensurate with the dust risk category.

16.6.2. There is not predicted to be a significant effect on local air quality as a result of construction traffic. No mitigation measures other than standard mitigation measures are therefore considered necessary.

16.6.3. There are no significant changes in concentrations of NO_2, PM_{10} and $PM_{2.5}$ as a result of the Proposed Scheme at human health receptors.

16.6.4. There will be an increase in regional emissions due to an increase in vehicle kilometres travelled. The changes in regional emissions of CO_2 can be considered to be insignificant when put in the context of regional or national emissions.

16.7. References

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