29 Air Quality

This chapter describes the local air quality impacts within 500m of the Southern Leg. Within this area, the impacts of the proposed scheme are expected to range from Moderate adverse to Slight beneficial. Most of the adverse impacts would be caused by exhaust emissions from vehicles using the new road. The beneficial impacts would be due to reduced traffic on existing roads. Most locations within 500m of the Southern Leg would experience adverse impacts, but air quality will remain very good with or without the proposed scheme.

This assessment has not identified any requirement to mitigate the air quality impacts, other than those measures that are already built into the scheme design.

29.1 Introduction

29.1.1 Air pollutants emitted from road vehicles can worsen local air quality, which may lead to health effects or damage to particularly sensitive vegetation. A new road scheme will alter driving patterns and thus change the numbers of vehicles on particular roads, as well as potentially reducing congestion and changing driving speeds, and as such can influence local air quality not only close to the new road, but also across a much wider road network. Where a new road brings vehicles into an area, air quality is likely to deteriorate. At the same time, air quality is likely to improve near to roads that are relieved by the new road.

29.1.2 Nationally there are two local air pollutants of greatest concern in terms of road traffic: nitrogen dioxide and fine particles (normally measured as PM_{10} – particulate matter less than 10 micrometres diameter). Air quality assessments carried out by Aberdeen City Council (e.g. Aberdeen City Council, 2003a) and Aberdeenshire Council (e.g. Aberdeenshire Council, 2005) have confirmed that these are the only two road traffic pollutants of potential concern in this area. The assessment thus addresses the impacts of the proposed scheme on ambient concentrations of both nitrogen dioxide and PM_{10}. Concentrations of oxides of nitrogen (NOx, which covers nitrogen dioxide and nitric oxide) are also assessed in relation to areas of potentially sensitive vegetation.

29.1.3 Existing (2005) concentrations of these pollutants close to the proposed route are described. Concentrations are also predicted for the year 2011 both with and without the proposed scheme in place. For the purposes of this air quality assessment, 2011 has been assumed to be the opening year for the scheme, even though opening is actually expected to be 2012. Because of national and international measures that have been set in place to reduce emissions from road transport and many other sectors, current projections assume that concentrations of both nitrogen dioxide and PM_{10} will fall in the future. Thus, assessing 2011 is a worst-case approach.

29.2 Approach and Methods

Study Area

29.2.1 This chapter describes the local air quality impacts that are expected within 500m of the Southern Leg during its operation. This 'Southern Leg corridor' is shown in Figures 29.1a-c. As is explained in Appendix A14.1, this is only a small part of the overall study area for the air quality assessment, which extends 10km from the proposed scheme. Local air quality impacts outside of the route corridor, as well as total emissions and greenhouse gas emissions, are all addressed in Chapter 55 (Air Quality Cumulative Impact Assessment). Air quality impacts within 500m of the Northern Leg and Fastlink are addressed in Chapters 14 and 44 respectively. Air quality impacts during the construction phase are addressed in Chapter 33 (Disruption due to Construction).

29.2.2 The recommended approach to Stage 1 and 2 DMRB assessments is to assess air quality within 200m of all roads with significantly affected traffic flows (not just within 200m of the proposed scheme itself). This requirement does not apply to a Stage 3 assessment, and in this case a detailed dispersion model has been used that encompasses a wider study area that extends 10km from the proposed scheme. Results from the model are presented separately for the Northern Leg, Southern Leg and Fastlink corridors, so as to highlight the impacts that the proposed scheme will have on residents living close to the proposed route. To retain consistency with other sections of this ES, these corridors extend 500m to either side of the scheme. Impacts across the whole study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Policy Context

29.2.3 The air quality assessment has been carried out in accordance with the DMRB Volume 11, Section 3, 2003 and with reference to the following documents:

- The Environment Act 1995, Part IV;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum, 2003;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: A consultation document for further improvements in air quality, 2006;
- The Air Quality (Scotland) Regulations 2000; and
- The Air Quality (Scotland) Amendment Regulations 2002.

29.2.4 During May 2007, the Highways Agency published Advice Note HA 207/07 (Highways Agency, 2007), which supersedes Volume 11, Section 3, Part 1 of the DMRB (Highways Agency, 2003). The assessment reported in this chapter was carried out prior to May 2007 and thus references the previous publication. It is considered that if this assessment were to be carried out following the May 2007 guidance, the conclusions would be unaltered. Reference has also been made to Interim Advice Note 61/05 Highways Agency (2005), which has been issued as a supplement to DMRB Volume 11.3 (IAN 61/05 is now incorporated within Advice Note 207/07 (Highways Agency, 2007)). The implications of the above documents in terms of this air quality assessment are outlined below.

Local Air Quality

29.2.5 The significance of both existing and future pollutant concentrations is best assessed by reference to the national air quality standards and objectives, established by the Government 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 the costs, benefits, feasibility and practicality of achieving the standards. The objectives are prescribed within the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) Amendment Regulations 2002. The objectives for nitrogen dioxide were to be achieved by 2005 and will continue to apply in each subsequent year. The current objectives for PM_{10} were to be achieved by 2004 and will continue to apply in each subsequent year. The current PM_{10} objectives are, however, supplemented by a set of more stringent objectives to be applied from 2010 onward. A summary of these objectives is provided in Table 29.1. Patterns across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60 $\mu g/m^3$ (Laxen and Marner, 2003). Therefore, 1-hour mean nitrogen dioxide concentrations will only be considered in this assessment if the annual mean concentration is likely to be above this level.

29.2.6 The European Union has also set limit values for both nitrogen dioxide and PM_{10} and the UK has a legal obligation to meet these limits nationally. The EU limit value for nitrogen dioxide is the same level as the UK objective but is to be achieved by the later date of 2010. The EU limit values for PM_{10} are the same level as the 2004 UK objectives, and had to be achieved by 2005. Thus, assessing against the nitrogen dioxide and PM_{10} objectives for Scotland as set out in Table 29.1 provides the most stringent approach.

Table 29.1 – Air Quality Objectives for Pollutants Relevant to this Scheme, as Defined in the Air Quality (Scotland) Regulations 2000 and Amendment Regulations 2002

Pollutant	Air Quality Objective		Strategy Compliance Date
	Concentration $\mu g/m^3$	Measured as:	
Nitrogen dioxide (NO_2)	200	1 hour mean; not to be exceeded more than 18 times per year	31 December 2005
	40	Annual mean	31 December 2005
Particles (PM_{10}) (gravimetric)	50	24 hour mean; not to be exceeded more than 35 times per year	31 December 2004
	40	Annual mean	31 December 2004
	50	24 hour mean; not to be exceeded more than 7 times per year	31 December 2010
	18	Annual mean	31 December 2010

29.2.7 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 and its 2003 Addendum set out how different sectors can contribute to achieving the air quality objectives. Local Authorities are seen to play a particularly important role, and must each carry out a review and assessment of air quality in their area in order to identify whether the objectives will be achieved by the relevant date. If this is not expected to be the case, the Authority must declare an Air Quality Management Area (AQMA), and prepare an action plan for improvements in air quality. The AQMA can be larger than the area of exceedence if the Local Authority believes that this is beneficial.

29.2.8 The air quality objectives only apply at locations where members of the public are likely to be exposed to air pollution for the time period specified in the objective. Thus, for the annual mean and 24-hour objectives that are the focus of this assessment, the primary receptors will be residential properties. However, in order to ensure that all potentially sensitive locations were accounted for, the review of the Southern Leg corridor also included a search for any sensitive non-residential receptors such as schools.

Air Quality Impacts on Vegetation

29.2.9 There is evidence that elevated concentrations of NOx can damage particularly sensitive vegetation. In addition, there is evidence that the deposition of reactive nitrogen from the air can damage certain habitats. Critical levels have been defined to prevent gaseous pollutants directly affecting plants. Defra (2001) defines a critical level as '*the concentration of a pollutant in the atmosphere, below which vegetation is unlikely to be damaged according to present knowledge*'. In addition to the critical levels, critical loads have been defined to prevent the long-term effects of deposition. Defra (2001) defines critical loads as '*the amount of pollutant deposited below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge'*.

29.2.10 In the UK, the statutory nature conservation agencies use a critical level for NOx of 30 $\mu g/m^3$ at internationally designated conservation sites and SSSIs. The same level is also set as an EU Limit Value, which only applies more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas. The critical loads are specific to different types of habitat.

Assessment Criteria

29.2.11 As described in Chapter 5 (Overview of Assessment Process), impact significance has been determined with respect to the sensitivity of the baseline conditions and the magnitude of potential impact.

29.2.12 There is no official guidance for the UK on defining air quality impact magnitude and significance, and the criteria used in this assessment, and described below, are ultimately based on professional judgement. They are, however, the same as those defined by the Irish National Roads Authority in its Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (NRA, 2006) and are presented as an example in the Planning for Air Quality guidance prepared by the National Society for Clean Air and Environmental Protection (NSCA, 2006).

Sensitivity

29.2.13 In terms of the sensitivity criteria generally used within the ES (i.e. low, medium and high), all of the sensitive receptors at which air quality has been assessed are judged to be of high sensitivity. This is because the air quality objectives protect the health of all members of the public, and because in terms of ecosystem effects, the UK statutory nature conservation agencies treat all relevant SSSIs and other officially designated as sensitive.

Impact Magnitude

29.2.14 The definition of impact magnitude is solely related to the degree of change in pollutant concentrations. The impact magnitude criteria are provided in Table 29.2.

able 29.2 – Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude	Increase/decrease	
	Annual Mean NO_2 / PM_{10}	Days PM10 >50 $\mu g/m^3$
very large	> 25%	> 25 days
large	15-25%	15-25 days
medium	10-15%	10-15 days
small	5-10%	5-10 days
very small	1-5%	1-5 days
extremely small	<1%	increase/decrease <1 day

Impact Significance

29.2.15 Impact significance takes account of the impact magnitude and also of the absolute concentrations and how they relate to the air quality objectives or other relevant standards. The impact significance criteria defined in Table 29.3 are consistent with the terminology generally used within the ES except that the additional category of 'Very Substantial' has been added. This criterion is commonly used in air quality assessments (e.g. NRA, 2006) to describe large or very large changes where an air quality objective would be breached.

Table 29.3 - Air Quality Impact Significance Criteria

Absolute Concentration in Relation to Objective	Magnitude of Impact (Change in Concentration)					
	extremely small	very small	small	medium	large	very large
Decrease With Scheme						
Above Objective With Scheme	Slight beneficial	Slight beneficial	Substantial beneficial	Substantial beneficial	Very Substantial beneficial	Very Substantial beneficial
Above Objective Without Scheme and Below Objective With Scheme	Slight beneficial	Moderate beneficial	Substantial beneficial	Substantial beneficial	Very Substantial beneficial	Very Substantial beneficial
Below (but not well below) Objective Without Scheme	Negligible beneficial	Slight beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Substantial beneficial
Well Below Objective Without Scheme	Negligible beneficial	Negligible beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Moderate beneficial
Increase With Scheme						
Above Objective Without Scheme	Slight adverse	Slight adverse	Substantial adverse	Substantial adverse	Very Substantial adverse	Very Substantial adverse
Below Objective Without Scheme and Above Objective With Scheme	Slight adverse	Moderate adverse	Substantial adverse	Substantial adverse	Very Substantial adverse	Very Substantial adverse
Below (but not well below) Objective With Scheme	Negligible adverse	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well Below Objective With Scheme	Negligible adverse	Negligible adverse	Slight adverse	Slight adverse	Slight adverse	Moderate adverse

Note: Below Objective = >75% of the objective level
Well Below Objective = <75% of the objective level

Assessment Methods

Local Air Quality

29.2.16 Air quality monitoring methods and collated data are summarised in this chapter, with further technical detail provided in Appendix A14.1.

29.2.17 Information on the existing levels of nitrogen dioxide within the overall air quality study area (as described in paragraph 29.2.1) has been obtained from direct measurements made over a 12 month period using passive diffusion tubes at 17 monitoring sites. These are shown on Figure A14.1. Away from roads, baseline annual mean concentrations will be spatially uniform and thus, even though only one monitoring site was within the Southern Leg corridor itself, the measurements made elsewhere in the study area provide a very good indication of concentrations in the Southern Leg corridor. Diffusion tube data have been corrected for laboratory bias as per guidance from Defra and the Devolved Administrations (DAs), as explained in full in Appendix A14.1.

29.2.18 The results of the passive diffusion tube monitoring have been supplemented with results of measurements made by Aberdeen City Council and Aberdeenshire Council, as part of on-going monitoring programmes. All of these measurements were made outwith the Southern Leg corridor. As explained in Appendix A14.1, the monitoring data provided by the Councils were the most recent available at the time this assessment was undertaken.

29.2.19 DMRB Volume 11.3 recommends that if a scheme is likely to give rise to significant impacts, the Stage 3 Assessment should involve detailed dispersion modelling. As the proposed scheme described in Chapter 4 (The Proposed Scheme) is likely to influence a very large area, some of which has been designated as an AQMA, detailed dispersion modelling has been undertaken.

29.2.20 Dispersion calculations were performed using the AAQuIRE model (described in detail at www.fabermaunsell.com), which is one of the models accepted by Defra and the DAs (2006b) for use in air quality review and assessment, and which is suitable for use in DMRB Stage 3 air quality assessments. The road-transport component of this model is based around the internationally validated CALINE model. The meteorological data required for modelling pollutant dispersion were taken from the Meteorological Office site at Dyce Airport, which is located within the overall study area and is thus ideally suited for this purpose. When modelling began, hourly data for 2005 were the most recent available and were therefore the most appropriate for use in this assessment.

29.2.21 The traffic data used in the air quality assessment were supplied by MVA. This is explained in more detail in Section 4.5 of Chapter 4 (The Proposed Scheme), and Section 5.3 of Chapter 5 (Overview of Assessment Process). The future-year traffic data have been provided for the year 2012, but have been entered into the dispersion model assuming the year is 2011. Because of anticipated trends in traffic volumes and vehicle emissions, this is a worst-case approach.

29.2.22 All of the roads contained within the traffic model that are within 10km of the proposed scheme have been entered into every run of the dispersion model. Thus, emissions outside of the Southern Leg corridor are taken into account when predicting concentrations. MVA advised that some of the baseline traffic flows on roads in Aberdeenshire may have been under-predicted, but this will not have occurred within the Southern Leg corridor and is not significant.

29.2.23 The model has been verified and calibrated against the full set of local measurements from both the study-specific passive diffusion tube monitoring and the measurements provided by Aberdeen City Council, as described in Appendix A14.1. The measurements provided by Aberdeenshire Council have not been used to verify the model because of the potential for under prediction of baseline flows in Aberdeenshire, as discussed above in paragraph 29.2.22.

29.2.24 In order to describe the most significant impacts of the proposed scheme within the Southern Leg corridor, 202 sensitive receptors have been chosen. This selection was based on professional judgement and as shown in Figures 29.1a-c, they represent locations that will experience the full range of scheme-related impacts. Receptors are positioned on the roadside façade of each property. Since air quality has been assessed at such a large number of receptors, numerical results are only presented for a selection of 20 receptors, which are labelled as SR1 to SR20 in Figures 29.1a-c. The labelled receptors were chosen to aid description of the results. They include the locations with the largest predicted impacts, as well as other locations that it is helpful to highlight. The results for the other receptors are summarised in Figures as described subsequently. The 24-hour PM_{10} results are not shown in Figures because the annual mean PM_{10} data are more likely to exceed the objectives, and the Figures therefore represent the worst-case scenario. Both the annual mean and the 24-hour PM_{10} results are discussed in the text.

29.2.25 The model requires information on background conditions within the study area. Since almost all road traffic in the region has been modelled explicitly (i.e. the road traffic model includes traffic on the vast majority of the road network), it would be inappropriate to use the national background concentration maps published by Defra and the DAs (2006a) without removing the road-traffic component of these data. The method used to transform the background concentration data is described in Appendix A14.1.

<u>Air Quality Impacts on Vegetation</u>

29.2.26 In accordance with Interim Advice Note (IAN) 61/05 to the DMRB (Highways Agency, 2005), an assessment of potential impacts on vegetation has been carried out. Any officially designated sites (i.e. SACs, SPAs, cSPAs, Ramsar sites or SSSIs) were identified within the Southern Leg corridor. The only site within the Southern Leg corridor is the River Dee SAC. Since deposition of reactive oxides of nitrogen to bulk water is so slow, any effects will be Negligible (Marner and Harrison, 2004) and thus, this site has been scoped out of any further assessment.

29.2.27 There is no requirement in the DMRB to assess impacts of air quality on farming activities Furthermore, the organic status of farmland is not jeopardised by the presence of a road (see Chapter 37: Land Use). It is, however, recognised that land-owners might be concerned about the potential for traffic-related air pollution to affect farmland. Since there is no set methodology for assessing the potential for such impacts, the pragmatic approach has been taken of treating any organic and biodynamic farmland within the Southern Leg corridor as if it were a SSSI, SAC, SPA or Ramsar site. This additional assessment is presented in Appendix A29.1.

Limitations to Assessment

29.2.28 All values presented here are the best possible estimates, but uncertainties in the results might cause over-predictions or under-predictions. All of the measurements presented in this chapter and Appendix A14.1 have an intrinsic margin of error. Defra and the DAs (2006c) suggest that this is of the order of +/- 20% for diffusion tube data and +/- 10% for automatic measurements. The model results rely on MVA's strategic traffic model and thus any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that during each year, the vehicle fleet within the study area will conform to the national (UK) average composition; it has been assumed the emissions per vehicle conform to the factors published in DMRB 11.3; it has been assumed that wind conditions measured at Dyce airport during 2005 will occur throughout the study area during 2011; and it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. As is explained in Appendix A14.1, an important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, the combined influence of the majority of these uncertainties can be assessed. This comparison is given in Figures A14.7 and A14.9 and Tables A14.1.4 and A14.5.1 of Appendix A14.1. The comparison shows that there is no significant bias in the results and that the model performs consistently well across both built-up urban areas and open rural areas.

29.2.29 The assessment is limited to certain pollutants which have been shown by other assessments to be the pollutants of greatest concern. It does not take account of all chemical species that might be released into the air, but it is considered that impacts associated with other pollutants will be smaller than those associated with the pollutants that have been considered.

29.2.30 The UK Government's Air Quality Expert Group (AQEG) has published a draft report on trends in primary nitrogen dioxide in the UK (AQEG, 2006). This examines evidence that shows that while NOx emissions have fallen in line with predictions made a decade previously, the composition of NOx has, in some urban environments, changed. This may have caused nitrogen dioxide levels at some locations to fall less rapidly than was expected. As is explained in Appendix A14.1, the latest guidance from Defra and the DAs has been followed regarding the relationship between NOx and NO_2, but there is still uncertainty as to whether this relationship will continue to apply in 2011. Any effect is likely to be greatest close to roads in the centre of Aberdeen, especially near to roads with a high proportion of buses, where future baseline concentrations may have been underestimated. The issue of primary nitrogen dioxide would not be expected to alter the comparison between concentrations with and without the proposed scheme. The implications for the conclusions of this assessment are therefore judged to be negligible.

29.2.31 The limitations to the assessment should be borne in mind when considering the results set out in subsequent sections. While the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. Clearly in future years the uncertainties are likely to be greater than they are now. The results are 'best estimates' and are treated as such in the discussion.

29.3 Baseline Conditions

Local Air Quality

29.3.1 Aberdeen City Council and Aberdeenshire Council have both carried out reviews and assessments of air quality over a number of years. They have not, to date, identified any likely exceedences of any of the air quality objectives within the Southern Leg corridor and thus no AQMAs have been declared within the Southern Leg corridor.

Nitrogen Dioxide

29.3.2 The assessment has drawn on an extensive range of measured data. However, as is explained in Section 29.2, only one of the measurement sites falls within the Southern Leg corridor. All measurements are presented in Appendix A14.1. Table 29.4 gives the measured concentration at the site within the Southern Leg corridor. This site is labelled in Figure A14.1 as site number 10. The monitor was affixed to the roadside façade of a residential property 9m from the edge of the A944 near Backhill of Brodiach. Despite this roadside setting, the measured annual mean concentration here was less than half of the level of the Government's air quality objective.

Table 29.4 – Measured Annual Mean Nitrogen Dioxide Concentration within the Southern Leg Corridor (June 2005 to June 2006) (μg/m^3)

Location	2005
Diffusion Tube 10	15
Objective	**40**

Note: Data are adjusted for bias as described in Appendix A14.1

29.3.3 Figures 29.1a-c show the annual mean nitrogen dioxide concentrations predicted by the model for each of the 202 sensitive receptors within 500m of the Southern Leg in 2005; which is taken to represent the current baseline situation. The results for 20 selected receptors are set out in Table 29.5. The largest annual mean nitrogen dioxide concentration at any of the 202 receptors is predicted at Receptor SR2 (adjacent to the A90 south of Charleston) as set out in Table 29.5. Even at this location, predicted concentrations are well below the objective level. Figures 29.1a-c shows that existing concentrations are also expected to be greater than 20 µg/m^3 very close to the A90 and at Receptor SR16, which is adjacent to the A944 at Backhill of Brodiach. Elsewhere, all of the predicted concentrations are less than half of the objective level. Away from roads, predicted concentrations are even smaller and reach as low as 4 µg/m^3 (e.g. Receptor SR5). In a national context, concentrations such as this are exceptional and are below the limit of detection for diffusion tubes, which are the most frequently used measurement technique (i.e. pollutant concentrations are too small to measure).

29.3.4 Figures 29.2a-c show the predicted annual mean nitrogen dioxide concentrations at all of the receptors in 2011 without the proposed scheme in place. The results for the 20 selected receptors are set out in Table 29.5. As noted in paragraph 29.1.3, ambient concentrations of nitrogen dioxide are expected to fall between 2005 and 2011 because of reduced emissions from road transport and many other sectors. The predicted concentrations reflect this change. None of the predicted concentrations in 2011 are more than half of the objective level and at the majority of receptors (180 of 202) predicted concentrations are less than 10 µg/m^3 which is one quarter of the objective level.

Table 29.5 – Summary of Predicted Annual Mean Nitrogen Dioxide Concentrations within the Southern Leg Corridor without the Proposed Scheme (µg/m^3)

Location	2005	2011
Receptor SR1	19	15
Receptor SR2	25	19
Receptor SR3	7	5
Receptor SR4	6	4
Receptor SR5	4	4
Receptor SR6	5	4
Receptor SR7	8	5
Receptor SR8	6	4
Receptor SR9	14	11
Receptor SR10	13	10
Receptor SR11	10	7
Receptor SR12	5	4
Receptor SR13	5	3
Receptor SR14	5	4
Receptor SR15	16	12
Receptor SR16	23	17
Receptor SR17	12	9
Receptor SR18	6	5
Receptor SR19	6	4
Receptor SR20	15	13
Objective	**40**	**40**

Particulate Matter (PM_{10})

29.3.5 The annual mean is the more stringent of the two PM_{10} averaging periods in terms of road traffic emissions. The PM_{10} figures therefore present only the annual mean data and not the 24-hour data, as this represents the worst-case scenario or precautionary approach in terms of objective exceedences. The 24-hour data are discussed in the text and presented in the tables.

29.3.6 Figures 29.3a-c show the predicted annual mean PM_{10} concentrations at all of the 202 sensitive receptors in 2005. The results for the 20 selected receptors are set out in Table 29.6. Table 29.6 also sets out the predicted number of exceedences of 50 μg/m^3 as a 24-hour PM_{10} concentration in 2005. The largest predicted annual mean PM_{10} concentration in 2005 is predicted adjacent to the A944 at Backhill of Brodiach (Receptor SR16) and at two of the receptors adjacent to the A90 (a concentration of 16 μg/m^3 was predicted at all three receptors). Elsewhere within the Southern Leg corridor, predicted concentrations in the 13 μg/m^3 to 18 μg/m^3 band are shown in Figures 29.3a-c around the A90 and A956 at Charleston (e.g. Receptors SR1 and SR2); adjacent to the A93 at Milltimber (e.g. Receptors SR9 and SR10); adjacent to the A944 (e.g. Receptors SR15 and SR17); and through Kingswells (e.g. Receptor SR20). Away from these locations, all of the predicted concentrations are less than 13 μg/m^3 in 2005.

29.3.7 Figures 29.4a-c show the predicted annual mean PM_{10} concentrations at all of the receptors in 2011 without the proposed scheme in place. The results for the 20 selected receptors are set out in Table 29.6. As noted in paragraph 29.1.3, concentrations of PM_{10} are expected to fall between 2005 and 2011 because of reduced emissions from road transport and many other sectors. As a result of these changes, all of the predicted PM_{10} concentrations within the Southern Leg corridor fall between 2005 and 2011, but some of this change is lost in rounding for presentation of the data (e.g. Receptors SR3 and SR4). The largest predicted concentration in 2011 is 16 μg/m^3, while the smallest is 10 μg/m^3. It should be noted that the air quality objectives for PM_{10} in Scotland will be more stringent in 2011 than in 2005. All of the predicted concentrations are below the relevant objectives.

29.3.8 There are no predicted exceedences of 50 μg/m^3 as a 24-hour PM_{10} concentration within the Southern Leg corridor in 2005 or 2011. This reflects the very clean air in this environment.

Table 29.6 – Summary of Predicted PM_{10} Concentrations within the Southern Leg Corridor without the Proposed Scheme

Location	Annual Mean Concentration (µg/m³)		No Days > 50 µg/m³	
	2005	2011	2005	2011
Receptor SR1	15	14	0	0
Receptor SR2	15	14	0	0
Receptor SR3	11	11	0	0
Receptor SR4	11	11	0	0
Receptor SR5	11	10	0	0
Receptor SR6	11	11	0	0
Receptor SR7	12	11	0	0
Receptor SR8	12	11	0	0
Receptor SR9	14	13	0	0
Receptor SR10	14	13	0	0
Receptor SR11	13	12	0	0
Receptor SR12	12	11	0	0
Receptor SR13	12	11	0	0
Receptor SR14	12	11	0	0
Receptor SR15	14	14	0	0
Receptor SR16	16	16	0	0
Receptor SR17	13	13	0	0
Receptor SR18	12	12	0	0
Receptor SR19	12	11	0	0
Receptor SR20	15	15	0	0
Objective	**40**	**18**	**35**	**7**

Note: All results gravimetric equivalent

29.4 Potential Impacts

Local Air Quality

Nitrogen Dioxide

29.4.1 Table 29.7 sets out the predicted annual mean nitrogen dioxide concentrations for 2011 without and with the proposed scheme for the 20 selected receptors; with the 2005 baseline results repeated for ease of comparison. Also shown is the impact magnitude and significance for these 20 selected receptors: defined according to the criteria set out in section 29.2 (Approach and Methods). Figures 29.5a-c show the predicted annual mean nitrogen dioxide concentration in 2011 with the proposed scheme at each of the 202 sensitive receptors. Figures 29.6a-c illustrate the change in annual mean nitrogen dioxide concentrations at each receptor that is attributable to the proposed scheme.

29.4.2 The differences between Figures 29.5a-c (with proposed scheme) and Figures 29.2a-c (without proposed scheme) are that some of the receptors near to the proposed route have moved from the 0-10 µg/m³ colour band to the 10-20 µg/m³ category while some receptors near to Charleston have moved from 10-20 µg/m³ down to 0-10 µg/m³. There are no other changes portrayed by these Figures.

29.4.3 The largest predicted annual mean nitrogen dioxide concentration in 2011 without the proposed scheme is 19 µg/m^3 at Receptor SR2. Concentrations at this location would fall to 16 µg/m^3 as a result of the proposed scheme. With the proposed scheme, the largest predicted concentration is at Receptor SR16; where concentrations would increase from 17 µg/m^3 to 19 µg/m^3 as a result of the scheme.

29.4.4 The impacts that the proposed scheme would have on annual mean nitrogen dioxide concentrations are best described in Figures 29.6a-c. These show that impacts across the Southern Leg corridor would range from Moderate adverse to Slight beneficial, with most of the changes being adverse. The predicted adverse impacts are near to the proposed scheme and to roads on which traffic flows would increase as a result of the proposed scheme. The predicted beneficial impacts are near to those roads on which traffic flows would fall as a result of the proposed scheme. Between Charleston and Cleanhill, predicted impacts range from Moderate adverse to Slight beneficial. Beneficial impacts are expected adjacent to the A90 (e.g. Receptors SR1 and SR2) associated with reduced traffic volumes. Traffic flows on all of the minor roads that are within the Southern Leg corridor between Charleston and Cleanhill are expected to reduce if the proposed scheme is implemented, but these changes in flow would be smaller than those on the A90 and on the AWPR itself. Thus, the pattern of air quality impacts between Charleston and Cleanhill (Figure 29.6a) is mixed, with some beneficial changes predicted, but mainly adverse impacts. The most significant adverse impacts east of Cleanhill junction occur close to the proposed route and well away from the A90 (e.g. Receptors SR3, SR4, and SR5). Between Cleanhill Junction and Milltimber, predicted impacts range from Moderate adverse to Slight beneficial, with most changes being adverse. The only beneficial impacts expected within this section of the Southern Leg corridor are adjacent to the B9077 (B979) southwest of Milltimber Brae. Elsewhere, predicted impacts are adverse (e.g. Receptors SR6-SR11). The only predicted beneficial impacts within the Southern Leg corridor north of Milltimber are in Kingswells (e.g. Receptor SR20), where the Chapel of Stoneywood to Fairley Road that runs adjacent to Receptor SR20 would be relieved by the proposed scheme. All of the other predicted impacts within the Southern Leg corridor are adverse.

29.4.5 Despite the very large increases in concentration that are predicted near to the proposed scheme (e.g. Receptors SR3-SR15 and SR17-19) concentrations at each one of the 202 receptors assessed would remain less than half of the objective level. Furthermore, concentrations at the majority of these receptors (155 of 202) are predicted to remain less than 10 µg/m^3 which is one quarter of the objective level. Concentrations such as these represent very clean air. A comparison of the number of properties at which improvements and deteriorations in air quality are expected across the entire study area is presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Table 29.7 – Predicted Annual Mean Nitrogen Dioxide Concentrations at Selected Receptors within the Southern Leg Corridor (µg/m^3)

Receptor	2005	2011		Impact Magnitude	Impact Significance
		No Scheme	With Proposed Scheme		
SR1	19	15	13	medium decrease	Slight beneficial
SR2	25	19	16	medium decrease	Slight beneficial
SR3	7	5	7	very large increase	Moderate adverse
SR4	6	4	7	very large increase	Moderate adverse
SR5	4	4	5	very large increase	Moderate adverse
SR6	5	4	9	very large increase	Moderate adverse
SR7	8	5	8	very large increase	Moderate adverse
SR8	6	4	11	very large increase	Moderate adverse
SR9	14	11	15	very large increase	Moderate adverse
SR10	13	10	13	very large increase	Moderate adverse
SR11	10	7	12	very large increase	Moderate adverse
SR12	5	4	10	very large increase	Moderate adverse
SR13	5	3	10	very large increase	Moderate adverse
SR14	5	4	12	very large increase	Moderate adverse
SR15	16	12	16	very large increase	Moderate adverse
SR16	23	17	19	medium increase	Slight adverse
SR17	12	9	13	very large increase	Moderate adverse
SR18	6	5	12	very large increase	Moderate adverse
SR19	6	4	10	very large increase	Moderate adverse
SR20	15	13	11	small decrease	Slight beneficial
Objective	**40**	**40**	**40**	-	-

Note: Impact magnitude descriptors based on unrounded numbers. For example, the predicted concentration at Receptor SR20 in 2011 with no scheme is 12.67 µg/m^3, while the predicted concentration in 2011 with the proposed scheme is 11.47 µg/m^3. If the change were calculated using the rounded numbers that are presented in the Table, a change of 2 µg/m^3, or 15% would be derived. A 15% change would be described as "medium" according to the criteria set out in Table 29.2. However, when the change is calculated using unrounded numbers, the calculated change is only 1.2 µg/m^3, or 9%. This change is thus assigned a "small increase" according to the criteria set out in Table 29.2.

Particulate Matter PM_{10}

29.4.6 Figures 29.7a-c show the predicted annual mean PM_{10} concentrations in 2010 at each of the 202 receptors within the Southern Leg corridor with the proposed scheme. Figures 29.8a-c illustrate the changes in annual mean PM_{10} concentrations at each receptor that are attributable to the proposed scheme. These changes are defined according to the impact magnitude and significance criteria set out in section 29.2 (Approach and Methods). The results for the 20 selected receptors are set out in Table 29.8, with the baseline results repeated for ease of comparison.

29.4.7 The differences between Figures 29.7a-c (with scheme) and Figures 29.4a-c (without scheme) are that some of the receptors near to the proposed route have moved from the 8-13 µg/m^3 colour band to the 13-18 µg/m^3 category while one receptor at Charleston has moved from 13-18 µg/m^3 down to 8-13 µg/m^3. The largest predicted concentration with or without the proposed scheme in place is expected at Receptor SR15. Even here, the stringent 2010 annual mean PM_{10} objective would not be exceeded.

29.4.8 The impacts the proposed scheme would have on annual mean PM_{10} concentrations are best described in Figures 29.8a-c. These show that impacts across the Southern Leg corridor would range from Moderate adverse to Slight beneficial, with most of the changes being adverse. The spatial pattern of these changes is very similar to that described for nitrogen dioxide, with adverse impacts expected close to the proposed route (e.g. Receptors SR3 through to SR19) and beneficial impacts near to the A90 at Charleston (e.g. Receptors SR1 and SR2) and at Kingswells (e.g. Receptor SR20). Some of the locations at which adverse impacts are expected are the same locations for which improvements in nitrogen dioxide have been predicted. The changes reflect the different response of each pollutant to factors such as average speed and vehicle fleet composition.

Table 29.8 – Predicted Annual Mean PM_{10} Concentrations at Selected Receptors within the Southern Leg Corridor (µg/m^3)

Receptor	2005	2011		Impact Magnitude	Impact Significance
		No Scheme	With Proposed Scheme		
SR1	15	14	13	very small decrease	Slight beneficial
SR2	15	14	14	very small decrease	Slight beneficial
SR3	11	11	11	small increase	Slight adverse
SR4	11	11	12	small increase	Slight adverse
SR5	11	10	11	small increase	Slight adverse
SR6	11	11	12	medium increase	Slight adverse
SR7	12	11	12	small increase	Slight adverse
SR8	12	11	13	large increase	Slight adverse
SR9	14	13	15	medium increase	Moderate adverse
SR10	14	13	14	small increase	Slight adverse
SR11	13	12	14	medium increase	Moderate adverse
SR12	12	11	13	medium increase	Slight adverse
SR13	12	11	13	large increase	Slight adverse
SR14	12	11	13	large increase	Slight adverse
SR15	14	14	15	small increase	Slight adverse
SR16	16	16	16	very small increase	Slight adverse
SR17	13	13	14	medium increase	Moderate adverse
SR18	12	12	13	large increase	Slight adverse
SR19	12	11	12	medium increase	Slight adverse
SR20	15	15	14	very small decrease	Slight beneficial
Objective	**40**	**18**	**18**	**-**	**-**

Note: All results gravimetric equivalent. Impact magnitude descriptors based on unrounded numbers, for example, the predicted concentration at Receptor SR3 in 2011 with no scheme is 10.8 µg/m^3, while the predicted concentration in 2011 with the proposed scheme is 11.4 µg/m^3. Both numbers round to 11 µg/m^3, even though the model predicts a 5.3% increase in annual mean concentration. In such cases, the relative impact of the scheme (i.e. whether air quality will deteriorate) can be predicted with some confidence, but if the change was calculated after rounding, this detail would be lost. Thus, in the case of Receptor SR3, the receptor is assigned a "small increase" based on the criteria set out in Table 29.2.

29.4.9 It is clear that within the Southern Leg corridor, many more properties would experience deteriorated air quality than would experience improved air quality as a result of the proposed scheme. However, concentrations would remain below the objectives across the area. A comparison of the number of properties at which improvements and deteriorations in air quality are expected across the entire study area is presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

29.4.10 The model results show that without or with the proposed scheme, there would be no exceedences of 50 μg/m^3 as a 24-hour mean PM_{10} concentration anywhere within the Southern Leg corridor. Thus, as noted above, even with the proposed scheme, air quality in this area will remain very good. These results are not presented in a table, as the numbers are all zero.

29.5 Mitigation

29.5.1 This assessment has not identified any requirement to mitigate local air quality impacts other than ensuring the proposed route and realigned side roads are as far from sensitive locations as practicable.

29.6 Residual Impacts

29.6.1 Because the impacts set out above are not considered to require any specific mitigation, the residual effects will be the same as those presented in the Potential Impacts section. These are summarised below.

Local Air Quality

Nitrogen Dioxide

29.6.2 Within 500m of the Southern Leg, the impacts of the proposed scheme are expected to range from Moderate adverse to Slight beneficial. The beneficial impacts would result from reduced traffic flows on existing roads near to the proposed route. Most of the adverse impacts would result from the direct effects of emissions from vehicles on the proposed new road. At every location, annual mean nitrogen dioxide concentrations would be less than half of the level set in the Government's health-based air quality objective with or without the proposed scheme in place. In a national context, concentrations such as these are considered to represent very clean air.

29.6.3 More locations are expected to experience adverse air quality impacts than would experience beneficial air quality impacts within the Southern Leg corridor. The net impacts on local air quality across the entire study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Particulate Matter (PM_{10})

29.6.4 Within 500m of the Southern Leg, the impacts of the proposed scheme are expected to range from Moderate adverse to Slight beneficial. As with nitrogen dioxide, the beneficial impacts would result from changes to traffic flows on existing roads near to the proposed route. Most of the adverse impacts would result from the direct effects of emissions from vehicles on the proposed new road. PM_{10} concentrations in 2011 will be below the Scottish objectives with or without the proposed scheme in place. In a national context, concentrations such as these are considered to represent very clean air.

29.6.5 More locations are expected to experience adverse air quality impacts than would experience beneficial air quality impacts within the Southern Leg corridor. The net impacts on local air quality across the entire AWPR study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

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