3 AIR QUALITY

3.1 Introduction

This Chapter reports on the effect of the proposed junction and access road improvements on the A77 at Symington and Bogend Toll on air quality. The Scheme would potentially affect air pollution levels, due to changes in traffic flows, as experienced by residents of properties along the scheme, as well as residents in the vicinity of any affected side roads.

Individual or groups of residential properties and potentially sensitive properties such as schools and hospitals within 200 m of the scheme and surrounding affected roads have been identified as the most significant receptors which may be affected, and have been used to assess the impact of the proposals on local air quality. In addition, any internationally designated nature conservations sites and Sites of Special Scientific Interest (SSSIs) located within 200 m of the scheme or surrounding affected roads are also considered as potentially sensitive receptors. Beyond 200 m from a road, the contribution of vehicle emissions to local pollution levels is not generally considered to be significant.

At the local scale this assessment focuses on concentrations of the pollutants: nitrogen dioxide (NO_2), fine particulate matter (PM_{10}), carbon monoxide (CO), benzene and 1,3 butadiene. A more generalised local appraisal focussing on the total number of properties affected is based on NO_2 and PM_{10} concentrations. At the regional scale, the total quantity of oxides of nitrogen (NO_x), PM_{10}, CO and total hydrocarbons (THC) produced with and without the Scheme has been calculated. The total quantity of carbon dioxide (CO_2) that would be produced by the Scheme has been used as an indicator of the impact on climate change. Finally, the assessment of impacts on designated nature conservation sites considers concentrations of NO_x and rates of nitrogen deposition.

The four assessments defined above (local, generalised local, regional and nature conservation) have been undertaken following the methodology as described in the Design Manual for Roads and Bridges (DMRB), and the subsequent Interim Advice Notes 54/04 and 61/05. The assessments are required for the following scenarios:

- The localised impact assessment at selected sensitive receptors has been carried out for the existing baseline in 2006 and the baseline and operation in the year of Scheme opening 2009, and 2010;
- The generalised local impact assessment estimates the change in NO_2 and PM_{10} pollution concentrations at all affected properties due to the operation of the Scheme in 2009;
- The regional impact assessment has been carried out for the existing baseline in 2006, the baseline and operation in the year of Scheme opening 2009 and in 2024,15 years after opening; and
- The nature conservation assessment is carried out for the current baseline year 2006 and the year of opening 2009.

The significance of the localised air quality impact is based on the change in the predicted pollution concentrations at each receptor, with and without the Scheme, and by comparison with the relevant air quality objectives and limit values. The significance of the generalised local air quality impact is based on the change in overall exposure of residents to road traffic pollution with and without the Scheme. The significance of the impact at a regional scale and on climate change is based on the change in the predicted total quantity of pollutants emitted with and without the Scheme in operation. The significance of the impact on nature conservation sites is based on the change in the predicted NO_x concentrations, with and without the Scheme, and by comparison with the relevant air quality objective. In addition, the change in the rate of nitrogen deposition with and without the Scheme and comparison with the 'critical load' for the relevant habitat is considered.

3.2 Methodology

3.2.1 Construction Impacts

Impact Assessment Methodology

Site preparation and construction works can generate dust emissions. Dust is defined in BS 6069:1994 as particulate matter in the size range 1 – 75 µm in diameter, and is produced through the action of abrasive forces on materials. Fine dust particles (PM_{10}) are defined as particles less than 10 µm in diameter, and are of the most concern regarding health effects. Large and intermediate size particles with a diameter greater than 10 µm make up the greatest proportion of dust generated by activities such as soil stripping, handling and storage of materials, and the movement of equipment on unsurfaced areas. It is therefore possible for construction dust to be generated without significantly increasing levels of PM_{10}.

Larger particles of dust are rapidly deposited from the air onto surfaces, including window ledges, cars and plants, located in the vicinity of the source of dust. The PM_{10} fraction of construction dust will be transported further than the larger particles but rapidly becomes diluted below the level at which adverse effects on health might occur.

It is very difficult to quantify likely emissions of construction dust as it depends on such a wide range of variables including ground conditions, weather conditions, method of working etc., therefore, it is not possible to accurately predict likely rates of dust deposition. In addition, there are no statutory UK or EC standards relating to deposition rates which impact on amenity or vegetation growth. Dust deposition rates of between 100 – 200 $mg/m^2/day$ have been associated with the onset of possible complaints and this criteria has been used for mineral sites. Significant impacts on vegetation are unlikely to occur at deposition rates less than 1000 $mg/m^2/day$. These criteria were developed for largely urban areas and as such are not considered appropriate for a scheme of this nature in this location. Therefore, a qualitative assessment of the likely magnitude of construction dust emissions has been carried out by ranking the potential magnitude of the dust impact of various activities from negligible to substantial.

Construction road traffic generates the main pollutants associated with road traffic, namely NO_2, PM_{10}, CO, and hydrocarbons including benzene and 1,3 butadiene.

No details of the likely volume or routes of construction traffic is currently available, therefore, an assessment of the impact on local air quality of the additional traffic cannot be made. However, current traffic flows on the A77 are around 35,000 vehicles per day, of which 10% are heavy duty vehicles (HDV). It is unlikely that construction traffic would result in an increase in traffic of 10% or more. Therefore, it is unlikely that emissions from construction traffic accessing the site will result in a significant adverse impact on local air quality.

Significance Assessment Methodology

The significance of the impact of construction dust has been assessed based on the proximity of the works to potentially sensitive receptors, the magnitude of the likely dust emissions and the likely duration (see Table 3.1). The criteria are qualitative estimates based on the collective experience of many practitioners, as presented in an extensive body of environmental assessment reports, and expert evidence. The criteria assume standard best practice dust mitigation measures are in place.

Table 3.1: Qualitative Construction Dust Assessment Criteria – with Standard Mitigation

Source		***Zone for Potentially Significant Effects*** ***(Distance from Source)***	
Scale	***Description***	***Soiling***	***PM10 ****
High	Large construction sites, with high use of haul routes	100 m	25 - 50 m
Medium	Moderate sized construction sites, with moderate use of haul routes	50 m	15 - 30 m
Low	Minor construction sites, with limited use of haul routes	25 m	10 - 20 m

* Based on 35 permitted exceedances of 50μg/m3 in a year

The construction of the Scheme has been categorised as a medium scale development due to the nature of the works to the A77 and the duration of the construction period (approximately 12 months). Therefore it is highly unlikely that adverse effects will occur at sensitive receptors at a distance greater than 50 m from the works.

3.2.2 Road Traffic Emissions

Impact Assessment Methodology

The incomplete combustion of fuel in vehicle engines results in the presence of hydrocarbons (HC) such as benzene and 1,3 butadiene, and CO and PM_{10} in the exhaust emissions. In addition, at the high temperatures and pressures found in vehicle engines, some of the nitrogen in the air and the fuel is oxidised to form NO_x, mainly in the form of nitric oxide (NO), which is then converted to NO_2 in the atmosphere, only NO_2 is associated with adverse effects on human health. CO_2 is produced by vehicle engines, as in any combustion process. Whilst CO_2 is not considered a pollutant at a local scale, it is significant at the regional/global scale due to its importance as a greenhouse gas, which contributes to the phenomenon of global warming. Better emission control technology and fuel specifications are expected to reduce emissions per vehicle over time.

The concentration of pollutants at a sensitive receptor, and the total quantity of pollutants produced by traffic on a road, is influenced by a number of factors including traffic flow, traffic composition and speed. A relatively large change in traffic flow, 10% or more, is often considered necessary to have a significant impact on pollutant concentrations. Therefore, the Study Area of the local air quality impact assessment includes the existing A77 affected by the works, the upgraded junctions and surrounding roads which undergo a change of 10% or more due to the Scheme.

The detailed assessment of the air quality impacts of the Scheme has been carried out following the approach set out in the DMRB (2003) and the subsequent Interim Advice Notes 54/04 and 61/05. The DMRB methodology requires that the magnitude of the air quality impacts are predicted in four ways as follows:

- Local impact assessment: predict actual concentrations of NO_2, PM_{10}, CO, benzene and 1,3 butadiene at individual sensitive receptors in the existing year (2006), the year of Scheme opening (2009) and 2010 with and without the Scheme;
- Generalised local impact assessment: estimate the overall change in exposure to NO_2 and PM_{10} at properties due to the Scheme. Estimates are provided for the year of Scheme opening (2009);
- Regional impact assessment: predict the total quantity of NO_x, PM_{10}, CO, CO_2 and THC produced in the existing year (2006), year of opening (2009) with and without the Scheme and the project design year (2024 -15 years after opening) with and without the Scheme;
- Nature Conservation Sites assessment: predict concentrations of NO_x and rates of nitrogen deposition at designated nature conservation sites for the existing year (2006) and year of opening (2009), with and without the Scheme.

The DMRB procedures outlined above are not intended to provide an accurate prediction of air quality in the vicinity of a road scheme. It was developed to indicate whether more complex and sophisticated modelling of air quality is required. A number of features of the DMRB procedures are designed to overestimate road traffic impacts on air quality, therefore, it can be assumed with

some confidence that a road scheme will not result in air quality problems if none are predicted using the DMRB methodology.

Local Impact Assessment

The local air quality impact assessment has been carried out for the years 2006, 2009 and 2010. Pollution concentrations have been predicted at nine individual receptors using the latest version of the DMRB prediction spreadsheet (v1.02). The choice of sensitive receptors considers locations close to the A77, the upgraded junctions, new access roads and surrounding affected roads where members of the public might reasonably be expected to be exposed over the averaging time of the relevant air quality objectives, refer to Figure 3.1.

Generalised Local Impact Assessment

The generalised local air quality impact assessment has been carried out for the year of Scheme opening, namely 2009, both with and without the Scheme. The number of properties in four distance bands 0 – 50 m, 50 – 100 m, 100 – 150 m and 150 – 200 m from the centre of the A77, the new roads associated with the upgraded junctions and surrounding affected roads are counted. The corresponding average NO_2 and PM_{10} concentration in each band is determined by predicting the concentration at a distance of 20 m, 70 m, 115 m, and 175 m from the road using the DMRB methodology. Total 'exposure' to each pollutant is determined by multiplying the average concentration in each band by the number of properties and summing the total across the four distance bands and across all road links.

The total exposure to each pollutant without the Scheme is subtracted from the total exposure with the Scheme; a positive number indicates an increase in exposure due to the Scheme and a negative number a decrease in exposure.

Regional Impact Assessment

The regional air quality impact assessment has been carried out for the years 2006, 2009 and 2024. CO_2 is included to enable the contribution of the Scheme to climate change to be assessed. The magnitude of the impact, in terms of the total quantity of pollution generated by the affected roads in the Traffic Model Study Area, has been predicted using the DMRB methodology.

Nature Conservation Sites Assessment

An assessment of the impact of a road Scheme on nature conservation sites is required if an internationally designated site or a SSSI is located within 200 m of the Scheme or any surrounding road which undergoes a change in traffic flow of 10 % or more due to the Scheme. No such sites have been identified; therefore, a nature conservation sites assessment has not been carried out.

Significance Assessment Methodology

Local Impact Assessment

The significance of the predicted change in traffic pollution levels at the nine selected sensitive receptors due to the operation of the Scheme, has been assessed by consideration of the magnitude of the change, improvement or worsening, between baseline and operation scenarios, and comparing the predicted levels with the current local air quality objectives and limit values.

Air quality objectives and target dates for the five main road traffic pollutants are prescribed in the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) (Amendment) Regulations 2002 (see Table 3.2).

The Limit Values are prescribed under the Air Quality Limit Values (Scotland) Regulations (2003), the most recent version of which was implemented in 2003 (see Table 3.2). The Limit Values Regulations transfer EU Directives on ambient air quality into UK law. Unlike the air quality objectives the Limit Values are legally binding on central government.

The value of the objectives and limit values are generally the same; it is simply the compliance date which differs. However, for PM_{10} The Air Quality (Scotland) (Amendment) Regulations 2002 introduced two new objectives, which are not prescribed as legally binding limit values.

The CO objective and limit value is specified as a maximum daily running 8 hour mean, this is not directly comparable with annual mean CO concentrations, as predicted by the DMRB. However, if the annual mean is less than 2 mg/m^3 it is unlikely the 8-hour mean objective would be exceeded.

Table 3.2: Current Air Quality Objectives and Limit Values (Scotland) (continued over)

Pollutant	*Limit Value/ Objective*	*Measured as*	*To be Achieved by*	
			Objective	*Limit Value*
Nitrogen Dioxide (NO_2)	40 μg/m^3	Annual mean	31/12/05	01/01/10
	200 μg /m^3 not to be exceeded more than 18 times/year	1 hr mean	31/12/05	01/01/10
Fine Particles (PM_{10})	40 μg /m^3	Annual mean	31/12/04	01/01/05
	50 μg /m^3 not to be exceeded more than 35 times/year	24 hr mean	31/12/04	01/01/05

Pollutant	Limit Value/ Objective	Measured as	To be Achieved by	
			Objective	Limit Value
	18 μg /m^3	Annual mean	31/12/10	-
	50 μg /m^3 not to be exceeded more than 7 times/year	24 hr mean	31/12/10	-
Carbon Monoxide (CO)	10 mg/m^3	Max daily running 8hr mean	31/12/03	1/1/2005
Benzene	16.25 μg/m^3	Running annual mean	31/12/03	-
	5 μg/m^3	Running annual mean	31/12/10	1/1/10
1,3-Butadiene	2.25 μg/m^3	Running annual mean	31/12/03	-

The significance of the magnitude of the predicted change in pollution concentrations due to the Scheme is assessed based on the change in annual mean NO_2 concentrations.

Table 3.3 illustrates the scale of significance used where NO_2 concentrations are well below the air quality objective and limit value.

Table 3.3: Significance of Changes in Pollution Concentrations

Magnitude of change in annual mean NO_2 concentration due to the Scheme (μg/m^3)	Significance
5 or more	Substantial
2 to less than 5	Moderate
1 to less than 2	Minor
0.1 to less than 1	Negligible
less than 0.1	No change

Generalised Local Impact Assessment

The significance of the generalised local impact assessment is based on the change in the calculated total 'exposure'. A positive value indicates an increase in pollution exposure, while a negative value indicates a decrease. The larger the value (positive or negative), the greater the change in pollution levels and the greater the number of properties affected.

In addition, the DMRB suggests that the following increases in pollution concentration in the 0-50 m distance band, represented by the concentration at a distance of 20 m from the road centre, should be considered as significant:

- An increase in annual mean PM_{10} levels of at least 1 $\mu g/m^3$;
- An increase in annual mean NO_2 levels of at least 2 $\mu g/m^3$.

The number of properties which experience an improvement, worsening, or no change in local air quality is also reported. Properties within a 50m distance band are ranked as experiencing no change in local air quality, if the change in the average concentration of annual mean PM_{10} and NO_2 in the band is less than 0.1 $\mu g/m^3$.

Regional Impact Assessment

The significance of the impact of the Scheme at the regional scale has been determined by comparing the total tonnes/year of NO_x, PM_{10}, CO and THC produced by the baseline and operational scenarios in 2009 and 2024.

The significance of the impact of the Scheme on climate change has been determined in the same way as for the regional impact assessment, using the total tonnes/yr of CO_2 produced in 2009 and 2024 following the introduction of the Scheme.

Existing Ambient Air Quality

A desk study of the following existing sources of information and monitoring data, relating to the pollutants NO_2, PM_{10}, CO, benzene and 1, 3 butadiene, has been carried out:

- South Ayrshire Review & Assessments of local air quality;
- Pollution monitoring results from existing relevant monitoring sites; and
- Estimated UK background pollution levels.

Ambient concentrations of NO_2, PM_{10}, CO, benzene and 1,3 butadiene in the local air quality Study Area are discussed with reference to the relevant air quality objectives and limit values (refer to Table 3.3).

The total pollution level at a receptor or a distance from the road centre includes a contribution from background pollution levels. The assessment of existing ambient air quality identifies relevant background pollution levels to be used in the local and generalised local DMRB predictions.

3.3 Consultations

A summary of the consultation undertaken as part of the air quality assessment is provided in Table 3.4.

Table 3.4: Consultation Summary

Consultee	*Comment*	*Response*
South Ayrshire Council Environmental Health	Reports and data on ambient air quality obtained	Incorporated into assessment

3.4 Baseline

3.4.1 Existing Ambient Air Quality

Local Authority Review and Assessments of Air Quality

The Scheme is located within South Ayrshire Council. Under the Environment Act 1995 all Local Authorities in the UK are required to undertake periodic 'Review and Assessments' of air quality within their area to determine if the air quality objectives are at risk of being breached. If any breaches are predicted the affected areas must be declared an Air Quality Management Area (AQMA) and an Action Plan drawn up to determine how pollution levels can be reduced.

South Ayrshire Council concluded from the first round of Review and Assessment in 2000 that there was no risk of exceeding the air quality objectives for the main road traffic pollutants benzene, 1,3 butadiene, CO, NO_2 and PM_{10}. The second round of Review and Assessment was carried out in 2003 and again concluded there was no risk of exceeding the air quality objectives for benzene, 1,3 butadiene, CO and NO_2. However for PM_{10}, a risk of exceeding the 2010 annual mean objective of 18 $\mu g/m^3$ was identified in two villages, Dailly and Tarbolton, due to domestic coal burning. In 2004, a detailed assessment of PM_{10}, based on monitoring results, concluded that the 2010 objective would not be exceeded at the two villages. A Progress Report issued in 2005 reaffirmed the conclusion that there was no risk of exceeding the air quality objectives for benzene, 1,3 butadiene, CO, NO_2 and PM_{10} anywhere in South Ayrshire. The most recent 2006 assessment also concluded there was no risk of exceeding the objectives. However, the Scottish Executive has requested that a more detailed assessment of PM_{10} levels is carried out in the centre of Ayr.

As a result of the Review and Assessments of air quality carried out by South Ayrshire Council no AQMAs have been declared.

Monitoring Data

Since 2000 South Ayrshire Council have carried out monitoring of benzene, using diffusion tubes, at a total of over 40 sites, including two sites in Symington. Due to

the low results obtained only four sites are currently operational, located in the towns of Maybole and Ayr. The maximum annual mean benzene concentration recorded in Symington in 2000/2001 is provided in Table 3.5. The results indicate there is no risk of exceeding the 2010 objective and limit value of 5 μg/m^3.

Table 3.5: Maximum Monitored Annual Mean Benzene Concentrations in Symington 2000/2001

Location	Max Annual Mean (μg/m^3)	Objective 2010 (μg/m^3)
A77, Symington	2.5	5
Kilmarnock Road, Symington	1.5	

The Council has carried out diffusion tube monitoring of annual mean NO_2 concentrations at over 30 sites since 2000. One kerbside site is located in Symington, the annual mean results are provided in Table 3.6. The NO_2 monitoring site in Symington is no longer operational as the results were well below the objective.

Table 3.6: Monitored Annual Mean NO_2 Concentrations in Symington

Location	Annual Mean NO_2 (μg/m^3)				
	2001#	2002*	2003*	2004*	2005*
Kilmarnock Road, Symington	14	13	18	15	13

Not bias adjusted
* Bias adjusted

The monitored NO_2 results indicate that there is no risk of exceeding the annual mean objective and limit value of 40 μg/m^3.

The Council has carried out short term monitoring of PM_{10} levels at a small number of locations including Dailly and Tarbolton, due to domestic coal burning and Prestwick Airport and the centre of Ayr, due to road traffic emissions. To date the results indicate exceedances of the objectives and limit values would be unlikely. However, further investigation of levels in the centre of Ayr is proposed. No monitoring of PM_{10} levels has been carried out in the vicinity of the Scheme.

Archive Background Data

The UK National Air Quality Information Archive provides annual mean background NO_2, NO_x and PM_{10} concentrations for the year 2004 and a variety of future years,

and CO, benzene and 1,3 butadiene concentrations for 2001 and a variety of future years. Background concentrations for the current baseline year of 2006, the year of opening 2009 and 2010 are calculated where required, using the year adjustment factors provided by the UK National Air Quality Information Archive.

The average background concentrations in the fourteen 1x1 km grid squares which make up the local air quality study area are provided in Table 3.7, see Figure 3.1. These average background levels are used in the generalised local air quality assessment. For the local air quality assessment, the background concentration for the individual 1x1 km grid square in which each of the nine selected receptors is located is used.

Table 3.7: Average Annual Mean Background Pollution Concentrations in the Local Air Quality Study Area

Pollutant	Annual Mean Concentration			
	2006	2009	2010	Objective (2010)
NO_2 (µg/m^3)	7.3	6.7	5.9	40
NO_x (µg/m^3)	9.2	8.1	7.6	-
PM_{10} (µg/m^3)	11.8	11.4	11.2	40 (18)
CO (mg/m^3)	0.12	0.09	0.09	<2*
Benzene (µg/m^3)	0.16	0.15	0.15	16.25 (5)
1,3 butadiene (µg/m^3)	0.05	0.04	0.04	2.25

* annual mean CO concentration equivalent to meeting the running 8-hour mean objective

Background pollution levels in the study area are very low, well below the current and 2010 objectives and limit values.

Local Air Quality Impact Assessment

The predicted baseline pollutant concentrations in 2006, 2009 and 2010 at the nine selected receptors in the vicinity of the Scheme and surrounding affected roads are presented in Tables 3.8a and 3.8b. The location of the selected receptors is shown on Figure 3.1.

Table 3.8a: Baseline Pollution Concentrations (No Scheme) (continued over)

Receptor	Year	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	
		Annual Mean	Annual Mean	No. days/ yr 24hr mean >50
R1: Kilmarnock Road, Symington	2006	15.8	15.0	0
	2009	13.8	13.7	0
	2010	12.5	13.3	0
R2: South Trynlow Cottage, Symington	2006	14.9	14.5	0
	2009	13.0	13.3	0
	2010	11.7	13.0	0
R3: Stocksbridge Cottage, Symington	2006	7.9	12.1	0
	2009	7.2	11.6	0
	2010	6.3	11.5	0
R4: Symington Road	2006	7.7	12.0	0
	2009	7.0	11.5	0
	2010	6.2	11.4	0
R5: Symington Road North	2006	7.2	11.9	0
	2009	6.8	11.5	0
	2010	6.0	11.3	0
R6: Brewlands Road, Symington	2006	7.4	12.0	0
	2009	6.8	11.5	0
	2010	6.0	11.3	0
R7: Kilmarnock Road, Whitelees	2006	16.3	14.9	0
	2009	14.2	13.5	0
	2010	12.9	13.1	0

Receptor	Year	NO_2 (µg/m^3)	PM_{10} (µg/m^3)	
		Annual Mean	Annual Mean	No. days/ yr 24hr mean >50
R8: Fairfield Manor, Bogend Toll	2006	7.6	11.7	0
	2009	6.9	11.3	0
	2010	6.1	11.2	0
R9: Tarbolton Road, Bogend Toll	2006	8.6	12.0	0
	2009	7.7	11.5	0
	2010	6.9	11.4	0
Objective (2010)		40	40 (18)	35 (7)

Table 3.8b: Baseline Pollution Concentrations (No Scheme) (continued over)

Receptor	Year	CO (mg/m^3)	Benzene (µg/m^3)	1,3 Butadiene (µg/m^3)
		Annual Mean	Annual Mean	Annual Mean
R1: Kilmarnock Road, Symington	2006	0.18	0.25	0.19
	2009	0.15	0.22	0.16
	2010	0.14	0.23	0.16
R2: South Trynlow Cottage, Symington	2006	0.17	0.23	0.18
	2009	0.14	0.21	0.15
	2010	0.13	0.21	0.15
R3: Stocksbridge Cottage, Symington	2006	0.12	0.16	0.06
	2009	0.10	0.15	0.05
	2010	0.09	0.16	0.04

Receptor	Year	CO (mg/m^3)	Benzene (µg/m^3)	1,3 Butadiene (µg/m^3)
		Annual Mean	Annual Mean	Annual Mean
R4: Symington Road	2006	0.12	0.16	0.06
	2009	0.10	0.14	0.05
	2010	0.09	0.15	0.04
R5: Symington Road North	2006	0.12	0.16	0.05
	2009	0.10	0.14	0.04
	2010	0.09	0.15	0.04
R6: Brewlands Road, Symington	2006	0.12	0.16	0.05
	2009	0.10	0.14	0.04
	2010	0.09	0.15	0.04
R7: Kilmarnock Road, Whitelees	2006	0.18	0.25	0.21
	2009	0.15	0.23	0.18
	2010	0.14	0.23	0.18
R8: Fairfield Manor, Bogend Toll	2006	0.12	0.16	0.06
	2009	0.10	0.15	0.05
	2010	0.09	0.16	0.05
R9: Tarbolton Road, Bogend Toll	2006	0.13	0.17	0.07
	2009	0.10	0.15	0.06
	2010	0.10	0.16	0.06
Objective (2010)		2*	16.25 (5)	2.25

* annual mean CO concentration equivalent to meeting the running 8-hour mean objective

The highest baseline pollution concentrations are predicted at R1, R2 and R7, as would be expected as these three receptors are located less than 30m from the centre of the A77. Baseline pollution levels are very low at the five receptors, R3, R4, R5 and R6, which are located along minor surrounding roads more than 200m from the A77. Baseline pollution levels are also low at R8, which is almost 200m from the A77. Levels are slightly higher at R9, which is around 150m from the A77.

The baseline pollution concentrations at all the selected receptors in all assessment years are below the current and 2010 air quality objectives. The predicted pollution concentrations decline from 2006 to 2010 as emissions per vehicle are reduced and the background level falls.

Generalised Local Air Quality Impact Assessment

The calculated total baseline 'exposure' to NO_2 and PM_{10} pollution is provided in Table 3.9, based on a count of all residential properties located within 200 m of the Scheme and surrounding affected roads (refer to Figure 3.1).

Table 3.9: Baseline Total 'Exposure' to NO_2 and PM_{10} (No Scheme).

Total Exposure - Pollution Concentration * No. Properties	
NO_2	*PM_{10}*
3009	4500

A total of approximately 281 properties are located within 200 m of the A77 affected by the Scheme, the upgraded junctions and surrounding affected roads.

Regional Impact Assessment

The total quantity of NO_x, PM_{10}, CO_2, CO and THC produced by baseline traffic in the Traffic Model Study Area in 2006, 2009 and 2024 are presented in Table 3.10.

Table 3.10: Baseline Total Traffic Emissions (No Scheme).

Year	***Total Quantity of Pollutants tonnes/yr***				
	NO_x	***PM_{10}***	***CO***	***THC***	***CO_2***
2006	98	3	76	12	16544
2009	80	2	65	10	16856
2024	59	2	73	11	20300

The variation in the quantity of baseline pollution emissions from 2006 to 2009 and 2024 is determined by the combination of the increase in vehicle kilometres travelled, which increases emissions over time, and the decline in emissions per vehicle, which reduces emissions over time.

3.5 Environmental Effects

3.5.1 Effects of Construction

Large and intermediate size particles with a diameter greater than 10 µm make up the greatest proportion of dust generated by activities such as soil stripping, handling and storage of materials, and the movement of equipment on unsurfaced areas. Therefore, construction dust does not necessarily increase existing levels of PM_{10} considerably. Particles between 10 and 75 µm in diameter are not normally associated with adverse effects on human health, their main potential effects are:

- Visual, the soiling of surfaces such as window ledges and cars causing annoyance;
- Physical and/or chemical contamination affecting e.g. laboratory and medical facilities;
- Coating of vegetation and soil affecting the growth of vegetation; and
- Contamination of watercourses.

Impacts on amenity at residential properties close to the upgraded junctions and new access roads, and dust impacts on agricultural land are considered to be the main potentially significant construction dust impacts.

For the purposes of the assessment of the temporary construction dust impacts, the likely junction and access road construction works have been estimated and divided into a range of activities (refer to Table 3.11). The potential magnitude of the dust impact of each activity has been ranked from negligible to substantial. Stopping up of sections of the central reserve is not considered to be a potentially significant source of dust.

During construction works, the most significant potential source of fugitive dust emissions would be activities involving the excavation and movement of potentially dusty materials such as soil and hardcore.

The removal of topsoil and the construction of the embankments requires the excavation and movement of considerable quantities of soil, therefore, these activities have been ranked as a severe potential to generate dust in the absence of mitigation.

Topsoil would be removed first and stored for re-use at the end of the construction process. Therefore, topsoil stockpiles could be in place for extended periods of time.

Hardcore to be used to construct the sub-base of the new sections of road at the two upgraded junctions and new access roads may also need to be stored on site.

The potential for stockpiles of materials to generate dust largely depends on the nature of the material. Earth is soft and friable compared to hardcore. However, hardcore generally has a lower moisture content than soil, therefore, they can both be a potentially significant source of dust.

Table 3.11: Construction Activities and Dust Generation Potential

Phase	Construction Activity	Potential to Generate Dust (no mitigation)	Potential to Generate Dust (with mitigation)[1]
Site Clearance	Clear vegetation	Negligible	Negligible
	Topsoil strip	Substantial	Moderate
Earthworks	Embankments	Substantial	Moderate
Drainage	Installation of pipes/ditches	Minor	Negligible
Road Construction	Sub base	Moderate	Minor
	Surfacing	Negligible	Negligible
Construction of bridges at upgraded junctions	Foundations	Minor	Negligible
	Substructure and superstructure	Minor	Negligible
	Sub base	Moderate	Minor
	Surfacing	Negligible	Negligible
Finishes	Safety barriers, fencing, landscaping	Minor	Negligible
Material Storage	Storage of topsoil and Hardcore	Moderate	Minor
Compounds	Operation of the construction compounds, delivery, storage and removal of materials	Moderate	Minor
Haul Road	Movement of vehicles and equipment on unsurfaced roads	Moderate	Minor

[1] see section 3.6 for details of mitigation

The regular movement of vehicles and equipment on unsurfaced areas can generate dust both from the surface and from debris picked up by the vehicles on

the wheels and underside of the vehicle while on site, in wet weather this can be transferred off site as mud.

To cause annoyance outside the construction site, dust must become airborne and reach a potentially sensitive receptor. The potential for dust to be lifted from the surface depends in part on the wind speed and the size of the dust particles. This potential is considerably reduced when the surface is wet, either from artificial dust suppression or from rainfall. Once airborne, the location of the impact of the dust depends on the direction of the wind.

3.5.2 Effects of Operation

Local Air Quality Impact Assessment

The predicted operational pollutant concentrations in the year of opening 2010 at the nine selected receptors in the vicinity of the Scheme and surrounding affected roads are presented in Tables 3.12a and 3.12b. The locations of the selected receptors are shown on Figure 3.1.

Table 3.12a: Operational Air Quality Levels (With Scheme) (continued over)

Receptor	*Year*	*NO_2 ($\mu g/m^3$)*	*PM_{10} ($\mu g/m^3$)*	
		Annual Mean	*Annual Mean*	*No. days/ yr 24hr mean >50*
R1: Kilmarnock Road, Symington	2009	13.9	13.7	0
	2010	12.6	13.4	0
R2: South Trynlow Cottage, Symington	2009	13.1	13.4	0
	2010	11.9	13.0	0
R3: Stocksbridge Cottage, Symington	2009	7.1	11.6	0
	2010	6.3	11.5	0
R4: Symington Road	2009	7.4	11.6	0
	2010	6.6	11.5	0
R5: Symington Road North	2009	5.6	11.2	0
	2010	6.4	11.4	0
R6: Brewlands Road, Symington	2009	7.2	11.6	0
	2010	6.3	11.4	0

Receptor	Year	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	
		Annual Mean	Annual Mean	No. days/ yr 24hr mean >50
R7: Kilmarnock Road, Whitelees	2009	14.1	13.5	0
	2010	12.9	13.1	0
R8: Fairfield Manor, Bogend Toll	2009	7.3	11.4	0
	2010	6.5	11.3	0
R9: Tarbolton Road, Bogend Toll	2009	7.7	11.4	0
	2010	6.8	11.3	0
Objective (2010)		40	40 (18)	35 (7)

Table 3.12b: Operational Air Quality Levels (With Scheme) (continued over)

Receptor	Year	CO (mg/m^3)	Benzene ($\mu g/m^3$)	1,3 Butadiene ($\mu g/m^3$)
		Annual Mean	Annual Mean	Annual Mean
R1: Kilmarnock Road, Symington	2009	0.15	0.22	0.17
	2010	0.14	0.23	0.17
R2: South Trynlow Cottage, Symington	2009	0.14	0.21	0.16
	2010	0.13	0.22	0.15
R3: Stocksbridge Cottage, Symington	2009	0.10	0.15	0.05
	2010	0.09	0.16	0.04
R4: Symington Road	2009	0.10	0.15	0.05
	2010	0.09	0.15	0.05
R5: Symington	2009	0.09	0.15	0.04

Receptor	Year	CO (mg/m^3)	Benzene (µg/m^3)	1,3 Butadiene (µg/m^3)
		Annual Mean	Annual Mean	Annual Mean
Road North	2010	0.09	0.14	0.04
R6: Brewlands Road, Symington	2009	0.10	0.15	0.05
	2010	0.09	0.15	0.05
R7: Kilmarnock Road, Whitelees	2009	0.15	0.23	0.18
	2010	0.14	0.23	0.17
R8: Fairfield Manor, Bogend Toll	2009	0.10	0.15	0.05
	2010	0.10	0.16	0.05
R9: Tarbolton Road, Bogend Toll	2009	0.10	0.15	0.06
	2010	0.10	0.16	0.05
Objective (2010)		2*	16.25 (5)	2.25

* annual mean CO concentration equivalent to meeting the running 8-hour mean objective

As for the baseline scenario, the highest operational pollution concentrations are predicted at R1, R2 and R7, located less than 30m from the centre of the A77. And the lowest at receptors, R3, R4, R5 and R6, which are located along minor surrounding roads, more than 200m from the A77.

The operational pollution concentrations at all the selected receptors are well below the current and 2010 air quality objectives.

Generalised Local Air Quality Impact Assessment

The calculated total operational 'exposure' to NO_2 and PM_{10} pollution is provided in Table 3.13, based on a count of all residential properties located within 200 m of the Scheme and surrounding affected roads, see Figure 3.1.

Table 3.13: Operational Total 'Exposure' to NO_2 and PM_{10} (With Scheme).

Total Exposure - Pollution Concentration * No. Properties	
NO_2	PM_{10}
3031	4506

Regional Impact Assessment

The total quantity of NO_x, PM_{10}, CO_2, CO and THC produced by operational traffic in the Traffic Model Study Area in 2009 and 2024 are presented in Table 3.14.

Table 3.14: Operational Total Traffic Emissions (With Scheme).

Year	Total Quantity of Pollutants tonnes/yr				
	NO_x	PM_{10}	CO	THC	CO_2
2009	81	2	66	10	16950
2024	60	2	73	11	20421

The variation in the quantity of operational pollution emissions from 2009 to 2024 is determined by the combination of the increase in vehicle kilometres travelled, which increases emissions over time, and the decline in emissions per vehicle, which reduces emissions over time.

3.5.3 Significance of Environmental Effect

Effects of Construction

Construction dust can only have a significant impact on sensitive receptors if a receptor is located in fairly close proximity to the activity generating dust. The potential for dust to be transferred off site, to affect PM_{10} levels or cause a nuisance, is likely to be limited to around 50 m from the works to upgrade the two junctions and construct new accesses. Stopping up of sections of the central reserve is not considered to be a potentially significant source of dust. A total of approximately 33 residential properties have been identified within 50 m of the boundary of the junction and access road works.

Due to the nature of construction works, construction dust impacts are temporary. The construction process would be completed in around 12 months, between 2008 and 2009.

Based on the number of receptors near to the works and the likely duration of works such as topsoil stripping and embankment construction in close proximity (less than 50 m) to the identified receptors, the significance of the construction dust impact is ranked as moderate adverse.

The incorporation of effective site management procedures and the mitigation measures to control dust as outlined in Section 3.6 would ensure that the impact of the construction works on nearby sensitive receptors would be minimised.

Effects of Operation

Local Air Quality Impact Assessment

The significance of the predicted operational pollution concentrations at the nine selected sensitive receptors has been assessed by comparison with the air quality objectives and limit values, and consideration of the magnitude of the change in concentration compared to the baseline for the same year.

No exceedances of the current or 2010 air quality objectives or limit values for NO_2, PM_{10}, CO, benzene and 1,3 butadiene are predicted at any of the selected receptors due to the operation of the Scheme.

The predicted change in pollutant concentrations due to the Scheme in the year of opening 2009, and 2010 at the nine selected receptors in the vicinity of the Scheme and surrounding affected roads are presented in Tables 3.15a and 3.15b.

Table 3.15a: Change in Air Quality Levels (With Scheme-No Scheme) (continued over)

Receptor	*Year*	*NO_2 (µg/m^3)*	*PM_{10} (µg/m^3)*	
		Annual Mean	*Annual Mean*	*No. days/ yr 24hr mean >50*
R1: Kilmarnock Road, Symington	2009	+0.1	+<0.1	+<1
	2010	+0.1	+<0.1	+<1
R2: South Trynlow Cottage, Symington	2009	+0.1	+0.1	+<1
	2010	+0.1	+<0.1	+<1
R3: Stocksbridge Cottage, Symington	2009	-<0.1	-<0.1	-<1
	2010	-<0.1	-<0.1	-<1
R4: Symington Road	2009	+0.4	+0.1	+<1
	2010	+0.3	+0.1	+<1

Receptor	Year	NO_2 (µg/m^3)	PM_{10} (µg/m^3)	
		Annual Mean	Annual Mean	No. days/ yr 24hr mean >50
R5: Symington Road North	2009	-0.3	-0.1	-<1
	2010	-0.4	-0.1	-<1
R6: Brewlands Road, Symington	2009	+0.4	+0.1	+<1
	2010	+0.4	+0.1	+<1
R7: Kilmarnock Road, Whitelees	2009	-<0.1	-<0.1	-<1
	2010	-<0.1	-<0.1	-<1
R8: Fairfield Manor, Bogend Toll	2009	+0.4	+0.1	+<1
	2010	+0.4	+0.1	+<1
R9: Tarolton Road, Bogend Toll	2009	-0.1	-<0.1	-<1
	2010	-0.1	-<0.1	-<1

Table 3.15b: Change in Air Quality Levels (With Scheme-No Scheme) (continued over)

Receptor	Year	CO (mg/m^3)	Benzene (µg/m^3)	1,3 Butadiene (µg/m^3)
		Annual Mean	Annual Mean	Annual Mean
R1: Kilmarnock Road, Symington	2009	+<0.01	+<0.01	+0.01
	2010	+<0.01	+<0.01	+0.01
R2: South Trynlow Cottage, Symington	2009	+<0.01	+<0.01	+0.01
	2010	+<0.01	+<0.01	+0.01
R3: Stocksbridge Cottage, Symington	2009	-<0.01	-<0.01	-<0.01
	2010	-<0.01	-<0.01	-<0.01

Receptor	Year	CO (mg/m^3)	Benzene (µg/m^3)	1,3 Butadiene (µg/m^3)
		Annual Mean	Annual Mean	Annual Mean
R4: Symington Road	2009	+<0.01	+<0.01	+<0.01
	2010	+<0.01	+<0.01	+<0.01
R5: Symington Road North	2009	-<0.01	-<0.01	-<0.01
	2010	-<0.01	-<0.01	-<0.01
R6: Brewlands Road, Symington	2009	+<0.01	+<0.01	+<0.01
	2010	+<0.01	+<0.01	+<0.01
R7: Kilmarnock Road, Whitelees	2009	-<0.01	-<0.01	-<0.01
	2010	-<0.01	-<0.01	-<0.01
R8: Fairfield Manor, Bogend Toll	2009	+<0.01	+<0.01	+<0.01
	2010	+<0.01	+<0.01	+<0.01
R9: Tarbolton Road, Bogend Toll	2009	-<0.01	-<0.01	-<0.01
	2010	-<0.01	-<0.01	-<0.01

The Scheme will result in a negligible reduction in pollution levels at two of the selected receptors R5 and R9. At R5, Symington Road North the stopping up of the access directly on/off the A77 reduces traffic flows on Symington Road North to almost zero, resulting in a negligible reduction in pollution concentrations at R5. At R9, Tarbolton Road, the operation of the new junction reduces traffic flows on Tarbolton Road by almost 40%, which outweighs the impact of traffic on the new junction, resulting in a negligible decrease in pollution concentrations.

The Scheme will result in a negligible increase in pollution levels at receptors R1, R2, R4, R6 and R8. At R1, Kilmarnock Road, Symington Road is relocated from the west of the property to the east, at the same distance away. Traffic flows on the first section of Symington Road off the A77 decrease by around 20%, however, flows on the A77 increase by around 5% and traffic on the new bridge also contributes, resulting in an overall negligible increase. At R2, South Trynlow Cottage, the negligible increase is due to an increase in traffic on the A77 of around 5% and the contribution from traffic on the new junction. At R4 and R6, located within Symington, traffic on the adjacent local road increases by around 50% and 80% respectively. However, the absolute traffic flows are still very low, less than 3000 vehicles per day, resulting in a negligible increase in pollution levels. At R8,

Fairfield Manor, traffic on the adjacent B730 increases by around 30% and traffic using the new bridge also contributes, resulting in a negligible increase in pollution levels.

The Scheme results in no change in pollution levels at R3 and R7. At R3, Stocksbridge Cottage, traffic flows on Symington Road increase by around 50%, which cancels out the benefit from relocating the road further away. At R7, Kilmarnock Road, Whitelees, traffic on the A77 reduces very slightly, by around 2%, which cancels out the additional, though very small, contribution from the new access road to the south of the property.

Generalised Local Air Quality Impact Assessment

The change in the calculated total 'exposure' to NO_2 and PM_{10} pollution is provided in Table 3.16.

Table 3.16: Change in Total 'Exposure' to NO_2 and PM_{10} (With Scheme-No Scheme)

*Total Exposure - Pollution Concentration * No. Properties*	
NO_2	*PM_{10}*
+22	+6

The magnitude of the increase in total exposure to NO_2 and PM_{10} suggests a negligible adverse impact to the community as a whole due to the Scheme.

Of the total of 281 properties located within 200 m of the Scheme and surrounding affected roads, 25 properties (9%) would experience a negligible improvement in local air quality, 112 (40%) a negligible worsening of local air quality and 144 (51%) no change in local air quality.

A breakdown of the location and indicative magnitude at the most affected properties of the changes in exposure to local air pollution is provided in Table 3.17.

Table 3.17: Location of Changes in Exposure to NO_2 and PM_{10} (With Scheme-No Scheme)

	No.	Location	Magnitude
Better Due to Scheme	18	Along A77 (South Symington, Jeanfield, Muirend House, Whitelees, Bogend Toll)	Negligible
	7	Symington Village	Negligible
Worse Due to Scheme	6	Along A77 (South Symington, Bogend Toll)	Negligible
	15	Brewlands Road north east of Symington	Negligible
	91	Symington Village	Negligible
No Change	44	Along A77 (Brockett, Rosemount, Hansel Village, Danepark, South Symington, Whitelees, Coodham Estate)	-
	2	Stocksbridge	-
	98	Symington Village	-

No roads meet the DMRB criteria for a significant change in annual mean PM_{10} of at least 1 µg/m^3 or NO_2 of at least 2 µg/m^3, at a distance of 20m.

Regional Impact Assessment

The change in the total quantity of NO_x, PM_{10}, CO_2, CO and THC produced by traffic in the Traffic Model Study Area in 2009 and 2024 due to the Scheme are presented in Table 3.18.

Table 3.18: Change in Total Traffic Emissions (continued over)

Year	Change in Total Emissions of Pollutants tonnes/yr				
	NO_x	PM_{10}	CO	THC	CO_2
2009	+<1 (0.4%)	+<1 (0.4%)	+1 (0.8%)	+<1 (0.7%)	+94 (0.6%)

2024	+<1 (0.4%)	+<1 (0.5%)	+1 (0.9%)	+<1 (0.8%)	+121 (0.6%)

The Scheme results in a negligible increase in emissions of traffic pollutants and the greenhouse gas CO_2. This is due to the negligible increase (+0.7%) in total vehicle kilometres travelled in the traffic model study area with the scheme in operation.

3.6 Mitigation

3.6.1 Mitigation During Construction

Standard good practice mitigation measures to be adopted during Scheme construction, as recommended in the latest CIRIA and BRE guidance, would be employed during the construction process and contained in the contract documents, including:

- Minimising the handling of materials such as soil;
- Minimising drop heights;
- Immediate clearance of spillages of dusty material;
- Use of water bowsers during dry and/or windy conditions to damp down material stockpiles and unsurfaced areas e.g. haul roads;
- Avoid overfilling of lorries;
- No burning of materials on site;
- Locate construction compounds and material stockpiles away from sensitive receptors where possible;
- Restricting vehicle speeds on unsurfaced haul routes and all unsurfaced areas to 20 mph;
- Regular use of road sweepers, mechanical brushes or similar as appropriate on local off-site roads, to remove any material tracked out of the site;
- Regular maintenance of site access/egress points to ensure cleanliness and safe standards; and
- Careful location of haul routes to keep vehicles as far as possible from sensitive locations.

The use of such good practice measures should minimise the potential for dust to be generated by the majority of construction activities.

The site manager would have responsibility on a day to day basis for determining if either the nature of the activities on site or the weather conditions are likely to result in the transfer of dust off site. If so, remedial action would be taken to minimise emissions, including the temporary suspension of works.

3.6.2 Mitigation During Operation

The operation of the Scheme results in negligible changes in local air quality at sensitive receptors, therefore no mitigation measures are required.

3.7 Residual Impacts

With standard best practice mitigation measures in place as outlined above, the magnitude of the potential construction dust impacts at the 33 receptors located within 50 m of the junction and access road works is ranked as moderate, when works are carried out at the closest edge of the Scheme. Based on the number of receptors close to the works and the likely duration of works such as topsoil stripping in close proximity to the identified receptors, the significance of the residual construction dust impact is ranked as moderate adverse.

No measures are required to mitigate the impact of the operation of the Scheme on local and regional air quality therefore the significance of the residual operational impact is negligible adverse.

3.8 Summary

This Chapter reports on the predicted effects of the proposed A77 Symington and Bogend Toll improvements on air quality. Dust generated during construction and emissions from road traffic with and without the Scheme are considered.

A qualitative impact of the potential dust impacts of the junction and access road construction works has been carried out. During the construction works the activities with the greatest potential to generate dust are the initial stripping of topsoil and the earthworks to construct the embankments for the two new bridges. With standard best practice mitigation measures in place the magnitude of the potential construction dust impact during such activities is ranked as moderate.

Based on the type and scale of the construction works, totalling around 1 year, impacts within 50 m of the works have been considered. A total of 33 potentially sensitive receptors have been identified within 50 m of the works. Based on the number of receptors close to the works and the likely duration of works such as topsoil stripping in close proximity to the identified receptors, the significance of the construction dust impact is ranked as moderate adverse.

Concentrations of the main road traffic pollutants with and without the Scheme in place have been predicted at a selection of residential properties along the A77 and surrounding affected roads. Both baseline and operational pollution levels at all the selected residential properties are well below the current and 2010 air quality objectives and UK and EU limit values.

Overall the Scheme would have a negligible adverse impact on community exposure to road traffic pollution. A total of approximately 281 properties are located within 200 m of the A77, the upgraded junctions and surrounding affected roads. Of these, 9% would experience a negligible improvement in air quality, 40% a negligible worsening and 51% no change in air quality in 2009, the year of Scheme opening. At all properties within the study area the annual mean

concentrations of NO_2 and PM_{10} will change by less than 1 µg/m^3 and air quality is predicted to remain very good with or without the Scheme.

The total quantity of road traffic pollutants and the greenhouse gas CO_2 has been predicted with and without the Scheme in operation. The negligible increase in total vehicle kilometres travelled in the traffic model study area due to the scheme (+0.7%) results in a negligible increase in emissions of road traffic pollutants and CO_2.

The air quality impact assessment undertaken herein concludes that the Scheme would not result in any significant air quality problems due to changes in road traffic emissions – this is especially the case as the DMRB procedures that have been used are designed to over-predict traffic emissions. Thus, it can be assumed with confidence that no significant air quality problems would occur as a result of Scheme operation.