16. Air quality

16.1 Overview

The air quality assessment, based on the proposed concept design for the project, was undertaken to determine any potential impacts on sensitive land uses. It provides potential management and mitigation measures to achieve the air quality criteria adopted for the project.

Air quality effects were assessed on local sensitive receivers located within 35 metres of the project area. Most sensitive receivers are located on the western side of the existing Southern Expressway corridor in the suburbs:

- Sturt
- Morphett Vale
- Christie Downs
- Noarlunga Downs.

These sensitive receivers were identified for analysis given their proximity to the project corridor.

16.2 Legislative and policy requirements

Table 16.1 summarises key legislation, policies and guidelines relevant to air quality associated with the project.

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Description</th>
<th>Relevance to project</th>
</tr>
</thead>
</table>
| National Environment Protection Measure for Ambient Air 2003 (Ambient Air NEPM) (Commonwealth) | Sets out national ambient air quality standards and goals for six common air pollutants including: nitrogen dioxide (NO₂), carbon monoxide (CO), sulfur dioxide and particulates (PM₁₀ and PM₂.⁵)  
  The standards and goals in the Ambient Air NEPM are designed to be measured to give an ‘average’ representation of general air quality for large urban populations. The monitoring protocol was not designed for assessing air quality at locations adjacent to major roads and industrial premises. | South Australia has adopted the Ambient Air NEPM guideline levels for air quality, under Section 28A of the Environment Protection Act 1993 and the National Environment Protection Council Act 1994 (NEPC Act). Ambient Air NEPM limits apply as environment protection policies (EPPs) and are to be taken into account by the SA Environment Protection Authority (EPA) in assessing air quality concerns and issues. |
| National Environment Protection Measure for Air Toxics 2004 (Air Toxics NEPM) (Commonwealth) | Concerns collecting data on ambient (outdoor) levels of pollutants at locations where elevated levels are expected to occur and the population is likely to be exposed. Air toxics exist in relatively low concentrations in ambient air. Elevated levels are associated with locations close to specific sources (e.g. clusters of industrial sites, heavily trafficked or congested roads and areas affected by wood smoke). | SA has adopted the Air Toxics NEPM guideline levels for air quality, under Section 28A of the Environment Protection Act and the NEPC Act. Air Toxics NEPM limits apply as EPPs and are to be taken into account by the EPA in assessing air quality concerns and issues. |
Legislation Description Relevance to project

Environment Protection Act 1993 (SA) Dealing with the protection of the environment and polluting activities, and is administered and enforced by the SA Environment Protection Authority. In relation to air quality, Section 25 of the Act states: A person must not undertake an activity which pollutes, or might pollute the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm. Construction and operation of the proposed project must comply with the Act, including Section 25.

Environment Protection (Air Quality) Policy 1994 (Air Quality EPP) (SA) Governs the regulation of air pollution. Specifies maximum pollution levels for stack emissions, providing for the regulation of industrial pollution and associated source monitoring where required. Does not deal specifically with sources of diffuse pollution, such as motor vehicles. Construction and operation activities for the proposed project should comply with maximum permissible pollution levels specified in this Policy insofar as they are relevant.

16.2.1 Air quality guidelines

Regulation of air pollution is primarily governed through the Air Quality EPP. The Schedule to the Air Quality EPP specifies the maximum pollution levels that may be discharged from chimneys (stacks), providing for the regulation of industrial pollution and associated source monitoring and testing where required. The policy does not deal specifically with sources of diffuse pollution such as motor vehicles.

South Australia has also adopted Ambient Air and Air Toxics NEPM guideline limits for air quality through the Environment Protection Act and National Environment Protection Council (South Australia) Act 1995. Thus the NEPM limits apply as the EPPs under Section 28A of the Environment Protection Act. Such policies are to be taken into account by the EPA in assessing air quality concerns and issues.

Air quality criteria are listed in Table 16.2.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Concentration</th>
<th>Averaging period</th>
<th>Maximum number of allowable exceedances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ppm</td>
<td>µg/m³</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>9</td>
<td>10,000</td>
<td>8 hours</td>
</tr>
<tr>
<td>NO₂</td>
<td>0.12</td>
<td>246</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>0.03</td>
<td>62</td>
<td>Annual</td>
</tr>
<tr>
<td>PM₁₀₅</td>
<td>–</td>
<td>50</td>
<td>24 hours</td>
</tr>
<tr>
<td>PM₂₅</td>
<td>–</td>
<td>25</td>
<td>24 hours</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>8</td>
<td>Annual</td>
</tr>
</tbody>
</table>

ppm: parts per million; µg/m³: micrograms per cubic metre; PM₁₀₅: particulate matter with fine particles less than 10 microns in diameter; PM₂₅: particulate matter with fine particles less than 2.5 microns in diameter
16.3 Assessment methodology

The air quality assessment has been conducted in accordance with the South Australian Environment Protection Authority (EPA) Air Quality Assessment Methodology Guidelines 2006 which requires modelling of pollutant dispersion to assess the air quality effect of a development that is likely to have some polluting effect on the ambient environment. Three contaminants were modelled: CO, NO$_2$ and fine particles (PM$_{10}$).

16.3.1 Construction air quality assessment

During the assessment of air quality impacts from construction, potential impacts on air quality (such as dust) were also considered and management and mitigation measures recommended.

16.3.2 Operational air quality assessment

The following scope of works and methodology was adopted for modelling and assessment of the air quality impact of emissions from a duplicated Southern Expressway:

- Inspect concept design drawings and the site, and identify sensitive receivers (based on distance from the corridor and experience of air quality modelling specialist) that could potentially be impacted by air emissions from construction and operation of the project. Sensitive receivers were identified as those located within 35 metres of the project corridor.

- Review relevant State and Commonwealth environmental legislation for the maximum acceptable air quality impact, including pollutants stipulated in the Ambient Air NEPM and Air Toxics NEPM.

- Use traffic data and vehicle emission factors to prepare an emissions inventory for traffic on the expressway before and after implementation of the project.

- Estimate existing air quality in the study area for baseline purposes to enable assessment of any changes from the project.

- Obtain information from relevant EPA monitoring station data on the behaviour of pollutants and particulates in the region, and calibrate the model to local conditions.

- Model the potential impacts of operation of the project.

- Assess the impact on local and regional air quality and compare predicted levels with current air quality objectives.

- Assess potential impacts during construction of the project.

- Outline the likely air quality effects of the project and identify potential mitigation and management measures.

16.4 Existing air quality

16.4.1 Background information

Adelaide has a good network of air quality monitoring stations from which patterns and trends in air quality conditions can be established. For this project, air quality data from Elizabeth, Netley and
Christie Downs air quality monitoring stations in Adelaide were examined to derive a suitable background level for the project.

Data from the nearest EPA monitoring sites was used to determine existing background air quality conditions along the Southern Expressway:

- wind records at Christie Downs, Netley and Elizabeth monitoring sites
- air quality conditions in 2009 at all EPA monitoring sites in Adelaide
- hourly CO concentrations in 2010 at Elizabeth monitoring site
- hourly NO₂ concentrations in 2010 at Netley and Christie Downs monitoring sites
- hourly fine particles (PM₁₀) levels in 2010 at Netley and Christie Downs monitoring sites.

16.4.1.1 Carbon monoxide

According to the National Pollutant Inventory for South Australia, 80% of the CO in metropolitan Adelaide is emitted by motor vehicles. The only monitoring station in Adelaide that records CO is located at Elizabeth. All the recorded CO levels at Elizabeth are well below the Ambient Air NEPM 8-hour limit of 9 ppm, with the 99 percentile measurements being 0.3 to 0.8 ppm, and the maximum level reached being 1.4 ppm. The data indicated a clear trend of decreasing levels of CO over time reflecting the improved emission controls installed in motor vehicles. However, levels of CO are higher 8.00–11.00 a.m. (corresponding to morning traffic peak with a time delay) and 6.00–8.00pm (afternoon traffic peak with a delay).

The design limit for CO is specified for a 1-hour averaging time; the ambient standard is specified for an 8-hour averaging period. The background CO concentration must be specified for a 1-hour averaging period. The 90 percentile CO concentration of 0.3 ppm (on average) for 8-hour averaging corresponds to a 1-hour level of 0.6 ppm. However, taking into account the morning and afternoon peak in CO the concentration of CO selected as the conservative background level for the project is 0.8 ppm. The equivalent background concentration in mass units is 0.9 µg/m³.

16.4.1.2 Nitrogen dioxide

NO₂ is measured at five sites in metropolitan Adelaide: Elizabeth, Northfield, Netley, Kensington and Christie Downs. Analysis of the EPA data shows the mean 2009 concentration ranged from 0.005 ppm at Netley to 0.013 ppm at Christie Downs. The 90 percentile level ranged from 0.020 ppm at Netley to 0.026 ppm at Christie Downs. No measured values exceeded the NEPM limit for nitrogen dioxide of 0.12 ppm (1-hour average).

The data indicate a trend for slowly decreasing NO₂ levels as vehicle emission controls are becoming more stringent. The 90 percentile value at Christie Downs is the highest of the monitoring stations at 0.026 ppm (0.47µg/m³) and, the nearest monitoring site to the project, provides a conservative background concentration. The Christie Downs data indicated a trend for the higher values to be from the north-east, reflecting a higher background concentration when the wind carries vehicle emissions from the city (which has a high traffic density) to the southern suburbs.

16.4.1.3 Fine particles (PM₁₀)

PM₁₀ is measured at five sites in metropolitan Adelaide: Elizabeth, Northfield, Netley, Kensington and Christie Downs. High concentrations of PM₁₀ occur for three to four days each year. These days generally have either bushfires or strong northerly winds bringing dust from parched agricultural areas north of Adelaide. The high values, averaging PM₁₀ concentrations of 30 µg/m³ occur in February to April when bushfires and dust storms are more common. During the wetter winter months, PM₁₀ levels are lower. Other than during these extreme events, the PM₁₀ concentration does not appear to be strongly related to wind direction or wind speed. As a result of these results and discussions with the
EPA, it was considered appropriate to adopt the 90 percentile PM$_{10}$ value of 30 µg/m$^3$ as the background level for this analysis of local air quality.

16.4.1.4 Summary

The background concentrations adopted for the assessment of air quality impacts from the duplication of the Southern Expressway are:

- Carbon monoxide (CO): 0.9 mg/m$^3$ (900 µg/m$^3$)
- Nitrogen dioxide (NO$_2$): 0.047 mg/m$^3$ (47 µg/m$^3$)
- PM$_{10}$: 30 µg/m$^3$.

16.4.2 Meteorological conditions

Meteorology is fundamental to the dispersion of pollutants and, therefore, meteorological data (particularly wind and atmospheric stability conditions) must be carefully assessed and considered when assessing pollutant dispersion.

Several factors combine to influence the concentration of contaminants in the local atmosphere:

- sources and rates of emissions of the various contaminants
- wind speed and wind direction
- rate of turbulent mixing and dispersion
- background concentration (contribution from upwind sources)
- local topography and the horizontal and vertical distances between major sources of emissions and potential receivers (such as residences and schools).

Table 16.3 describes the factors influencing local air quality.

<table>
<thead>
<tr>
<th>Table 16.3 Factors influencing local air quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Sources and rates of emissions</td>
</tr>
<tr>
<td>Wind speed and direction</td>
</tr>
<tr>
<td>Turbulent mixing and dispersion</td>
</tr>
<tr>
<td>Background concentrations</td>
</tr>
<tr>
<td>Local topography</td>
</tr>
</tbody>
</table>
The meteorological data used for the air quality assessment was derived from EPA monitoring stations at Netley and Christie Downs, located near the northern and southern ends of the Southern Expressway.

At Netley, the dominant wind directions are from the south-west and north-east; south winds also are common. Winds from the north-west and east are relatively uncommon. In the night hours, the eastern and southern winds are more common, and wind speeds are generally weaker.

At Christie Downs, dominant wind directions are less apparent, as there is a similar proportion of winds from all directions; the south-west and north-east sectors are slightly favoured. For the night hours, winds from the north-east, east and south-east predominate, and wind speeds are generally weaker.

Christie Downs receives calmer wind conditions (i.e. little to no wind) than Netley, which has a very high proportion of weak winds from the north-east section. This is likely to reflect the night drainage breeze at the monitoring station from the land to the ocean. Strong winds at Netley come from the south-west. At Christie Downs, strong winds come from both the south-west and south. The median wind speed measured in 2010 was 2.6 metres per second (m/s) at Netley and 2.7 m/s at Christie Downs.

16.5 Air emissions inventory

Emission rates are determined from the number of vehicles, the composition of the vehicle fleet (particularly the proportion of freight and buses) and the emission rates corresponding to each component of the vehicle fleet.

16.5.1 Traffic volumes

Daily traffic volumes for the various years on each roadway near Main South Road interchange at Darlington and Main South Road interchange Old Noarlunga were discussed in Chapter 14 – Transport. These volumes have been used as part of the air quality assessment.

16.5.2 Daily traffic patterns

Currently, traffic volumes on the one-way reversible Southern Expressway show traffic volumes are concentrated in the morning and afternoon peak flows. The expected traffic pattern on the duplicated Southern Expressway is: low traffic volumes in the early morning, increase rapidly to a high volume for the morning peak and again for the afternoon peak, with traffic volume gradually decreasing through the evening hours.

16.5.3 Traffic composition

Trucks and commercial vehicles account for about 4.5–5.5% of average daily traffic volumes along the Southern Expressway. These proportions are low compared to other arterial roads (e.g. Port Wakefield Road) but reflect that commuter traffic is the major demand for travel on the Southern Expressway.

Emissions from trucks, particularly on NO\textsubscript{2} and PM\textsubscript{10} levels, are usually higher than from cars. However, given the low truck proportion of total traffic volume, cars will be the largest source of air contaminants.
16.5.4 Vehicle emissions

Emissions from vehicles include exhaust gases, leaks and evaporative losses from the fuel system and the engine and (in the case of particles) an allowance for the wear of tyres and brakes. In Adelaide, motor vehicles are a major source of urban air pollution with vehicle emissions contributing approximately:

- 80% of CO
- 65% of nitrogen oxides (NOx)
- 40% of volatile organic compounds
- 30% of particulate matter (PM) (EPA data).

Emissions of NOx will decrease for all vehicles, particularly trucks, over time as new emission standards for trucks were introduced in 2010. Similarly, emissions of PM$_{10}$ and CO will decrease over time, particularly from trucks.

Emission rates increase with speed (and fuel consumed) but the relationship between speed and emission rate is different for different vehicles: emissions increase by 2–20% between 60–80 kph. For South Australian vehicles overall, emissions of NOx increase by about 9% with an increase in speed from 60–80 kph, and about 15% from 60–100 kph.

Petrol cars are the largest source of CO emissions. Diesel cars and trucks are the largest source of PM$_{10}$ emissions.

Fleet emissions factors include allowances for older vehicles, grade and congestion. Vehicle fleet emissions factors reduce with time due to the increasing stringency of controls on vehicle emissions and on fuel quality.

16.6 Effects of the project on air quality

16.6.1 Construction

The main air quality concerns during construction are dust and the emissions of combustion particles by heavy construction equipment.

The construction of the project will involve major excavation, movement of fill and road materials, construction of significant lengths of road and changes to on-ramps and off-ramps. These construction activities have the potential to generate dust from excavations, and from stockpiles of soil and road construction materials.

Management and mitigation measures for the control of dust and emissions of combustion particles by heavy construction equipment are discussed in Section 16.7.

16.6.2 Operation

The concentration of NO$_2$, PM$_{10}$ and CO at the sensitive receivers identified in the suburbs of Sturt, Christie Downs, Morphett Vale and Noarlunga Downs along either side of the expressway, were predicted for each hour of the year. For the northern end of the carriageway, concentrations were predicted using the northern traffic figures and the Netley meteorological file; for the southern end concentrations were predicted using the southern traffic figures and the Christie Downs meteorological file. For all sections, background concentrations and fleet emissions factors calculated from traffic numbers and composition were used.
The air quality effect of the project is assessed against the stipulated Ambient Air NEPM criteria.

16.6.2.1 Carbon monoxide

The air quality assessment indicated a small increase in CO concentrations (Figure 16.1) due to the increase in traffic volume, partly compensated by the reduction in the overall CO emissions per vehicle kilometre.

Present and future concentrations of CO are well within the Ambient Air NEPM limit of 29 mg/m³.

![Southern Expressway - Carbon Monoxide Concentrations (NEPM Limit 29 mg/m³)](image)

**Figure 16.1** Existing and predicted CO concentrations along the Southern Expressway

16.6.2.2 Nitrogen dioxide

Traffic volumes in the northern part of the project area are higher than in the south (i.e. Old Noarlunga). The results (Figure 16.2) indicate an increase in NO₂ concentrations due to the increase in traffic volume, partly compensated by the reduction in emissions per kilometre. In both the northern and southern ends of the project area, existing and modelled future concentrations of NO₂ are within the Ambient Air NEPM limit of 220 µg/m³.

Thus present and future NO₂ concentrations are within the Ambient Air NEPM limit.
16.6.2.3 Particulates

Predicted PM$_{10}$ levels appear to be marginally above the Ambient Air NEPM limit of 50 µg/m$^3$. These marginal exceedances would be during periods with a high proportion of light winds from the north-east which align with the orientation of the Southern Expressway in the northern suburbs. The conditions are therefore not considered representative of the majority of the time for which the roadway is operational. Detailed consideration of PM$_{10}$ levels at the sensitive receivers in the northern end of the Southern Expressway will be explored during the detailed design of the project.

16.7 Mitigation measures to minimise effects

16.7.1 Construction

The contractor will develop an air quality management plan, as part of the project’s construction environmental management plan (CEMP), which will incorporate the management and mitigation measures of:

- developing a construction traffic management plan to advise all truck drivers, contractors and vehicular machinery operators of designated vehicle access routes and protocols
- positioning all haulage routes with heavy traffic away from sensitive receivers as much as practicable (ideally a minimum of 20 metres)
- restricting vehicle speeds on unsealed access routes (e.g. 20–40 kph) to minimise wheel-generated dust
- minimising engine idle times and queuing
- installing truck tyre cleaning stations or equivalent (e.g. rumble pads) at site boundaries for earth moving vehicles to minimise dust emissions or sediment drag out onto surrounding roads
- where practicable, covering truck loads with a potential for dust emissions during transport
- maintaining all fossil-fuelled plant and equipment for efficient operation
- installing appropriate emission control mechanisms (e.g. fabric filter on crushers, concrete batchers) to minimise air emissions
- regularly watering exposed surfaces, including exposed stockpiles and unsealed roadways, or sealing high use access tracks to suppress dust generation; if possible, covering stockpiles or using surfactants to increase the efficiency of these systems, for example:
  - polymer based crusting agents on stockpiles and exposed surfaces which have intermittent to low traffic flow
  - vegetable oil based agents (which act by agglomerating soil particles to increase threshold lift off velocity) on surfaces where traffic flow is heavy
- locating stockpiles away from sensitive receivers, where practicable
- restricting activities with high dust generating potential (including heavy excavations and drilling) during periods when strong winds are blowing towards sensitive regions
- engaging the affected community through actions including:
  - providing a project telephone information line answered by the project team
  - responding to queries on construction methodologies and to complaints/concerns from community members
  - providing regular updates to community members to inform them of proposed construction methodologies and upcoming work that could result in increased levels of dust
  - considering community input when updating the air quality management plan.

Part of the air quality monitoring plan would be to install on-site air quality monitoring devices in accordance with the Australian Standard 2922-1987 Ambient air – Guide for the siting of sampling units. Monitoring will be scheduled for the duration of the construction phase at a selected location outside the construction corridor in proximity to the nearest sensitive receiver. This type of monitoring will feed relevant information to the contractor who can detect times when construction might exceed the regulatory limits and deploy stricter mitigation measures, which could include decrease in construction works during days with high potential for dust.

16.8 Conclusion

Based on the results of the air quality assessment and modelling for the draft concept design, there is no potential adverse impact from CO concentrations in proximity to the identified sensitive receivers in the suburbs of Sturt, Morphett Vale, Christie Downs and Noarlunga Downs, nor from NO₂ concentrations in the project area. Predicted concentrations of PM₁₀ for the northern end are marginally above the NEPM PM₁₀ limit of 50 µg/m³. The highest concentrations of PM₁₀ are predicted to occur in the morning traffic peak at the northern end of the project corridor. Detailed consideration of PM₁₀ levels at the sensitive receivers in the northern end of the Southern Expressway will be explored during the detail design of the project. Mitigation measures will be considered during design and implemented during construction.