Roads and Maritime Services/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Preliminary Draft Major Development Plan

Chapter 12 Air quality

November 2019

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Air quality

This chapter provides a summary of the air quality assessment. It describes the existing air quality environment, identifies potential impacts during construction and operation, and provides measures to mitigate and manage the impacts identified. Further information is provided in Technical Working Paper 4 (Air Quality), Technical Working Paper 16 (Former Tempe Landfill Assessment) and Technical Working Paper 17 (Odour Assessment).

The SEARs relevant to air quality are listed below. There are no MDP requirements specifically relevant to air quality, however there is a requirement under section 91(1) of the Airports Act to assess the potential environmental impacts associated with a development (section 91(1)(h)), and to specify how those impacts may be dealt with (section 91(1)(j)). Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
14	**Air quality**	
14.1	The Proponent must undertake an air quality impact assessment (AQIA) for construction and operation of the proposal in accordance with the current guidelines.	Technical Working Paper 4 (Air Quality)
14.2	The Proponent must ensure the AQIA also includes the following: (a) demonstrated ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation 2010*;	Section 12.1
	(b) the identification of all potential sources and types of air pollution (including PM_{10}, $PM_{2.5}$, CO, NO_x, volatile organic compounds and odour sources) during construction and operation including mechanically generated combustion and transport related emissions and potential for landfill gas generation from the Tempe Tip site;	Sections 12.4 and 0
	(c) any proposed air quality monitoring;	Section 12.7
	(d) a cumulative local and regional air quality impact assessment including impacts generated by the operation of nearby key infrastructure proposals such as (but not limited to) the New M5, M4-M5 Link and Botany Rail Duplication; and	Section 12.6
	(e) proposed construction and operational management measures.	Section 12.7

12. Air quality

12.1 Assessment approach

New road infrastructure has the potential to result in the generation and emission of pollutants into the atmosphere during both construction and operation. Exhaust from construction vehicles and dust generated from unsealed exposed earth are common air quality issues during construction, which must be minimised to avoid nuisance impacts on surrounding sensitive receivers. There is the potential for odour impacts when construction is undertaken at former landfill sites. During operation, new roads alter the source of air quality impacts as a result of moving vehicles on the road network. This can include bringing vehicles into areas that do not currently experience vehicle traffic (associated with a new road), increasing vehicles on existing roads and reducing vehicles on other parts of the network as transport routes are altered.

Modelling of potential air emissions during construction and operation is undertaken to identify and assess the likely extent of such impacts. Air quality modelling includes considering background levels of pollutants, which informs an assessment of the main contributors to existing air quality. This enables potential impacts to be identified and appropriate mitigation and management measures to be selected.

An air quality assessment was carried out for the construction and operational stages of the project, in general accordance with relevant legislation, guidelines and policies. Potential air quality impacts during construction were assessed using a semi-quantitative, risk-based approach. Operational impacts were assessed using computer dispersion modelling generally in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2016b).

An overview of the approach to the assessment is provided below, including the legislative and policy context and a summary of the assessment methodology.

12.1.1 Legislative and policy context to the assessment

The assessment was undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations, POEO Act and the Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW) (the Clean Air Regulation)
- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2016b)
- *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (DEC, 2007a)
- *National Environment Protection (Ambient Air Quality) Measure* (the Air NEPM)
- *Technical Framework - Assessment and Management of Odour from Stationary Sources in NSW* (DEC, 2006b)
- *Guidance on the assessment of dust from demolition and construction* (Institute of Air Quality Management (IAQM), 2014)
- *Environmental Guidelines: Solid waste landfills* (NSW EPA, 2016a)
- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

12.1.2 Methodology

Study area

The study area for the air quality assessment is shown on Figure 12.1. This is the area where potential impacts were modelled by the operational air quality assessment. The study area extended well beyond the project site to enable potential air quality impacts associated with changes to traffic network conditions to be considered. These changes would include new motorway projects (eg M4-M5 Link and New M5) as well as other roads where traffic may be affected by the project.

The study areas for the odour and landfill gas assessments were confined to receptors immediately adjacent to the former Tempe landfill.

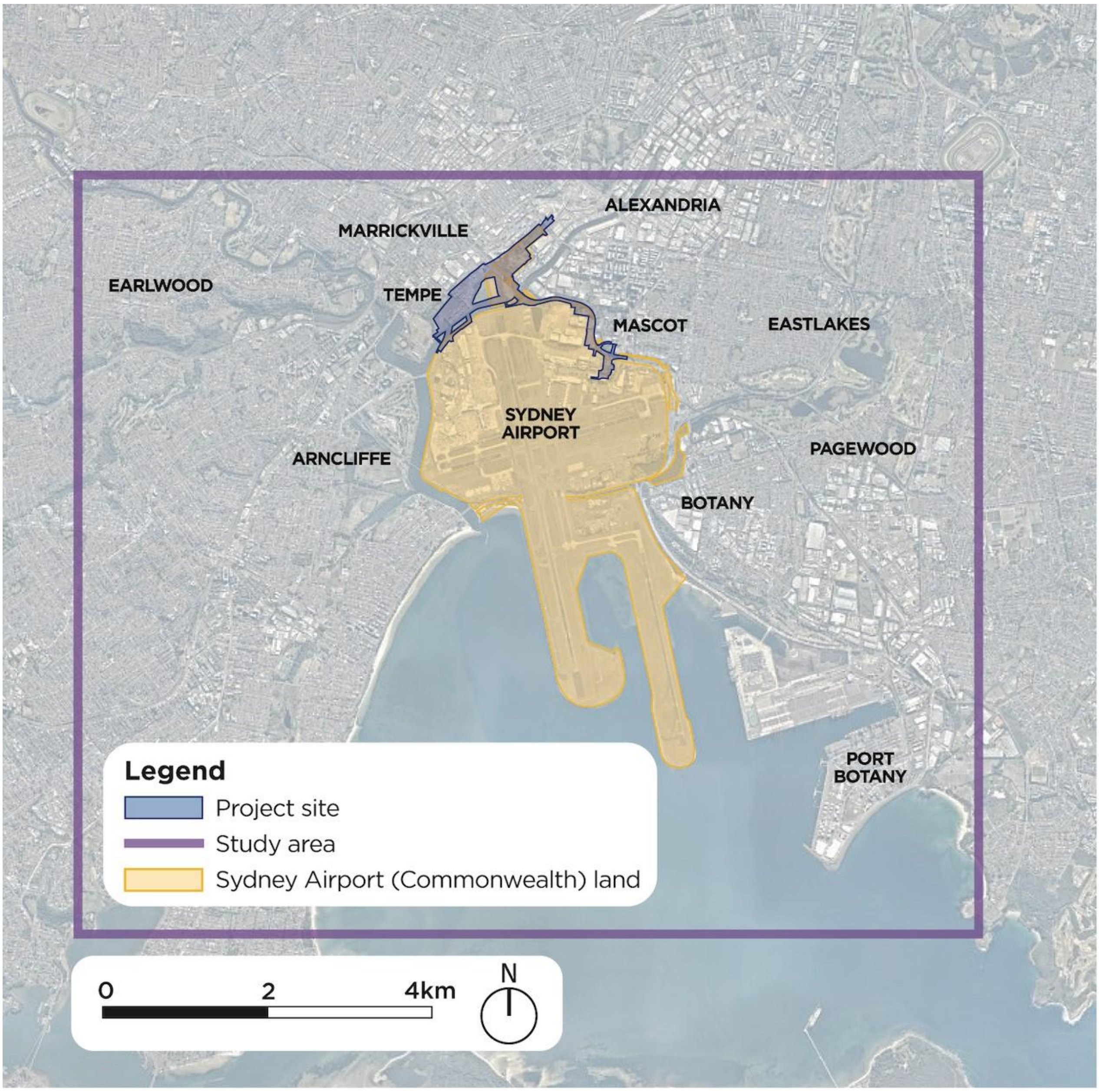

Figure 12.1 Air quality study area

Key tasks

Construction impact assessment

The assessment of potential impacts during construction considered the following emissions:

- Dust
- Exhaust emissions associated with the combustion of diesel fuel and petrol from construction plant and equipment
- Odour emissions due to the potential to uncover waste during works at the former Tempe landfill
- Landfill gas at the former Tempe landfill.

The construction assessment was desktop based. The assessment involved:

- A desktop review of the background air quality environment, including air quality and meteorological data sourced from the OEH and Roads and Maritime monitoring networks
- Identifying sensitive receptors with the potential to be adversely affected by air quality impacts
- Establishing project-specific assessment criteria
- Identifying and assessing potential construction dust impacts using a semi-quantitative, risk-based approach in accordance with *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014)
- Assessing potential odour impacts (as described below)
- Modelling the potential for landfill gas production using the Landfill Emissions Assistant model
- Considering cumulative impacts
- Identifying mitigation measures.

The air quality assessment was supported by an assessment of the potential for odour impacts during works at the former Tempe landfill. The odour assessment involved:

- A site visit to verify features of the existing environment and confirm odour sources
- Collating relevant project, geotechnical bore log and potential waste composition information, and analysing the potential interaction with the project
- Developing an odour emissions inventory
- Meteorological and dispersion modelling to predict potential odour impacts at nearby receptors in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2016b) (the Approved Methods)
- A sensitivity analysis to understand the potential impacts of a range of odour emission rates.

Two scenarios were considered by the odour modelling. Scenario 1 (worst case) considered the entire area of the proposed excavation emitting odour at the same time. Scenario 2 (realistic case) considered only a portion of the proposed excavation area (equating to about 30 per cent of the total) emitting odour at any one time. Assumptions have been made about waste types that would be excavated and expected odour emission rates.

Operation impact assessment

The assessment of potential air quality impacts during operation considered emissions from road traffic (major roads) as well as background concentrations from other sources, including industry, domestic activity, natural sources and minor roads. In the assessment, background concentrations were based on measurements from air quality monitoring stations at urban background locations.

Road traffic emissions were calculated using an emission model developed by the NSW EPA. Traffic data for the emission model was taken from the Strategic Motorway Planning Model.

Air quality was modelled for seven traffic operating scenarios, including the expected base year and six expected future traffic scenarios.

No operational odour assessment was considered required for the former Tempe landfill. This is because the waste would be completely enclosed (similar to the existing condition) and no odour emissions would occur. Similarly, no operational landfill gas assessment was undertaken as the concept design includes construction of a landfill gas collection and venting system to manage operational landfill gas impacts.

The main air pollutants considered included:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_x)
- Particulate matter (PM), including particulate matter 10 micrometres or less in diameter (PM_{10}) and particulate matter 2.5 micrometres or less in diameter ($PM_{2.5}$)
- Total hydrocarbons (THC)
- Sulfur dioxide (SO_2)
- Lead (Pb)
- Photochemical oxidants as ozone (O_3)
- Benzene
- Polycyclic aromatic hydrocarbons (PAH) as benzo(a)pyrene (B(a)P)
- Formaldehyde
- 1,3-butadiene
- Ethylbenzene.

Further information on the methodology, including a description of the modelling undertaken, is provided in section 3 of Technical Working Paper 4 (Air Quality) and Technical Working Paper 17 (Odour Assessment).

12.1.3 Risks identified

An environmental risk assessment was undertaken as an input to impact assessment (see Appendix G). This involved identifying potential environmental risks during construction and operation, and rating the potential risks according to likelihood, consequence and overall level of risk, in general accordance with *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*. Air quality risks with an overall assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- Temporary increases in dust resulting in health, ecological and amenity impacts on nearby sensitive receptors during construction
- Impacts on air quality from decommissioning and demolition activities causing increased dust and particulates, including potentially hazardous material
- Temporary increases in local odorous and non-odorous emissions, such as volatile organic compounds and methane, caused by disturbing materials at contaminated sites, including the former Tempe landfill, during construction
- Impacts on air quality as a result of vehicle and plant exhaust emissions during construction and operation.

These potential risks and impacts were considered as part of the air quality assessment.

12.2 Air quality criteria

Air pollutants

No specific criteria were applied for construction air quality impacts. This is due to the difficulty in quantifying dust emissions from construction activities and the ready ability to mitigate impacts through the adoption of standard construction measures. As described in section 12.1, a semi-quantitative, risk-based approach was used for the assessment.

Relevant assessment criteria from the Approved Methods for the main pollutants associated with operation of the project are presented in Table 12.1. While the Approved Methods do not strictly apply to Commonwealth land, they have been adopted for consistency for the project as a whole. The long-term goals for $PM_{2.5}$ in the National Environment Protection (Ambient Air Quality) Measure are also shown.

It is noted that Schedule 1 of the Airports (Environment Protection) Regulations 1997 also defines ambient air quality objectives at airports. Where the values are comparable, the values in the Airports (Environment Protection) Regulations 1997 are effectively the same as those in the Approved Methods, or are less stringent. Therefore, the criteria in the Approved Methods have been adopted for the operational air quality assessment for the project as a whole to provide a conservative approach to the assessment.

Table 12.1 Air quality criteria

Pollutant/metric	Concentration	Averaging period	Source
Criteria air pollutants[1]			
CO	30 mg/m^3	1 hour	NSW EPA (2016b)
	10 mg/m^3	8 hours (rolling)	NSW EPA (2016b)
NO_2	246 µg/m^3	1 hour	NSW EPA (2016b)
	62 µg/m^3	1 year	NSW EPA (2016b)
PM_{10}	50 µg/m^3	24 hours	NSW EPA (2016b)
	25 µg/m^3	1 year	NSW EPA (2016b)
$PM_{2.5}$	25 µg/m^3	24 hours	NSW EPA (2016b)
	20 µg/m^3 (goal by 2025)	24 hours	NEPC (2016)
	8 µg/m^3	1 year	NSW EPA (2016b)
	7 µg/m^3 (goal by 2025)	1 year	NEPC (2016)
Air toxics[2]			
Benzene	0.029 mg/m^3	1 hour	NSW EPA (2016b)
PAHs (as B(a)P)	0.0004 mg/m^3	1 hour	NSW EPA (2016b)
Formaldehyde	0.02 mg/m^3	1 hour	NSW EPA (2016b)
1,3-butadiene	0.04 mg/m^3	1 hour	NSW EPA (2016b)
Ethylbenzene	8 mg/m^3	1 hour	NSW EPA (2016b)

Notes: 1. Criteria air pollutants are those air pollutants that have been regulated and are used as indicators of air quality based on criteria that relate to health and/or environmental effects

2. These compounds were taken to be representative of the much wider range of air toxics associated with motor vehicles. Air toxics are pollutants that have the potential to cause serious harm to human health and/or the environment

Odour

Assessment criteria for odour are applied at the nearest existing, or likely future, off-site sensitive receptor. Odour assessment criteria take into account the frequency of exposure (set at the 99th percentile) and the intensity of the odour (set at between two to seven odour units).

The 99th percentile level is a prediction of the odour level that may occur 99 per cent of the time or, expressed differently, 99 hours in 100 hours are below these levels. Odour performance criteria are designed to be precautionary so that impacts on sensitive receivers can be minimised.

The most stringent criterion of two odour units at the 99th percentile was adopted for the assessment as this is considered acceptable when there is the potential to affect large populations (more than 2,000 people), as are present in the study area.

12.3 Existing environment

12.3.1 Ambient air quality

Local emission sources

Local emission sources, including industry and domestic activity, natural sources and local transport, can all contribute to existing air quality. A desktop review identified the following potential air pollution sources in the study area:

- Industrial facilities that reported air emissions
- Exhaust emissions from road and rail networks and aviation
- Commercial businesses, such as service stations and smash repairs
- Domestic activities, such as wood-fired home heaters and lawn mowing
- Emissions of methane and landfill gas from the former Tempe landfill.

General characteristics

Ambient air quality in Sydney is influenced by a number of factors, including topography, prevailing meteorological conditions (such as wind and temperature, which vary seasonally) and local and regional air pollution sources (such as motor vehicles, industrial facilities and bushfires). Consequently, regional air quality can be highly variable and impacted by events occurring a significant distance away.

Air quality in Sydney has generally improved over the last few decades. The improvements have been attributed to initiatives to reduce emissions from industry, motor vehicles, businesses and residences.

Historically, elevated levels of CO were generally only encountered near busy roads but concentrations have fallen as a result of improvements in motor vehicle technology. Since the introduction of unleaded petrol and catalytic converters in 1985, peak CO concentrations in central Sydney have plummeted, and the last exceedance of the air quality standard for CO in NSW was recorded in 1998 (DECCW, 2009b; 2010a).

While levels of NO_2, SO_2 and CO continue to be below national standards, levels of ozone and particulates (PM_{10} and $PM_{2.5}$) still exceed the standards on occasion. Ozone and particulate matter levels are affected by:

- Variability in the weather
- Natural events such as bushfires and dust storms, as well as hazard-reduction burns. A dramatic example of this was the dust storm that swept across Eastern Australia between 22 and 24 September 2009
- The location and intensity of local emission sources, such as wood heaters, transport and industry (OEH, 2015b).

In addition to the local road network, Sydney Airport is another major contributor to overall air emissions in the area. For the purposes of the air quality assessment, the resultant concentrations from Sydney Airport have been captured in the ambient air quality monitoring data.

Existing monitoring results

Table 12.2 provides an overview of historical trends in Sydney's air quality (2004 to 2017) based on hourly data from the following long-term monitoring stations operated by OEH and Roads and Maritime, and consideration of shorter term data from other air quality monitoring stations within the study area:

- OEH stations (urban background) - Chullora, Earlwood, Randwick, Rozelle
- Roads and Maritime (M5 East urban background)
- Roads and Maritime (M5 East roadside).

A detailed analysis of the results is provided in Technical Working Paper 4 (Air Quality).

Table 12.2 Long term monitoring results

Pollutant	Averaging period	Comment (for the period 2004 to 2017)
CO	Maximum 1-hour and rolling 8-hour	All values were well below the air quality criteria of 30 mg/m^3 (1-hour) and 10 mg/m^3 (8-hour). There were general downward trends in maximum concentrations, and these trends were statistically significant at most stations.
NO_2	Annual mean	Concentrations at all stations have been well below the air quality criteria of 62 µg/m^3. The long-term average NO_2 concentrations at the Roads and Maritime M5 East roadside stations were around 10 µg/m^3 higher than those at the M5 East background stations. Even so, the concentrations at the roadside stations were also well below the criteria.
	Maximum 1-hour	Although variable from year to year, maximum NO_2 concentrations have been quite stable in the longer term. The values across all stations have typically varied around 100 µg/m^3 and continue to be well below the criteria of 246 µg/m^3.
PM_{10}	Annual mean	In recent years, the annual mean concentration at OEH stations has been between 17 µg/m^3 and 20 µg/m^3. The concentrations at the Roads and Maritime background stations appear to have stabilised at around 15 µg/m^3. These values can be compared with air quality criteria of 25 µg/m^3. The measurements from the Roads and Maritime roadside sites show that PM_{10} levels are marginally higher than background levels.
	Maximum 24-hour	Maximum 24-hour PM_{10} concentrations exhibited no trend with time, and there was a large amount of variation from year to year. The roadside values were similar to the background values.
$PM_{2.5}$	Annual mean	$PM_{2.5}$ has been measured over several years at two OEH stations in the study area. Concentrations at Chullora and Earlwood showed a similar pattern, with a systematic reduction between 2004 and 2012 being followed by a substantial increase in 2013. The main reason for the increase was a change in the measurement method. The increases meant that background $PM_{2.5}$ concentrations in the study area between 2013 and 2017 were already very close to or above the standard in the Air NEPM of 8 µg/m^3, and above the long-term goal of 7 µg/m^3.
	Maximum 24-hour	There has been an underlying increase in concentrations between 2014 and 2017, such that they are currently above the NSW criteria of 25 µg/m^3. In most years, the maximum concentrations have been above the NEPM long-term goal of 20 µg/m^3.

The former Tempe landfill has a landfill gas collection and venting system to manage potential landfill gas impacts. The system extends to the boundary of the IKEA site on the northern boundary of the site. The system includes a series of six metre tall vent stacks fitted with wind-driven ventilators that extend to a sub-surface gravel filled trench and wells. During the site inspection, no observable odours were recorded.

Monitoring of methane conducted at the site indicated that landfill gas is present in the waste mass but is not produced in sufficient volumes to record gas flows or gas under pressure.

The Sydney Airport northern lands carpark area (adjacent to the former Tempe landfill) also has a gas collection and venting system, which was installed in 2015 as part of remediation works at the site. Potential impacts on this infrastructure is considered in Chapter 13 (Contamination and soils).

12.3.2 Nearby receptors

The study area includes a varied and relatively dense mix of land uses. Sydney Airport is by far the dominant land use in the study area. In addition to Sydney Airport and other transport uses (such as roads and the Botany Rail Line), the study area also includes a range of commercial and industrial land uses, residential areas and open space.

Construction

Dust

Guidance on the assessment of dust from demolition and construction specifies that a dust assessment is required where there are human receptors within 350 metres of the boundary of a site. Figure 12.2 shows receptors located within 350 metres of the project site.

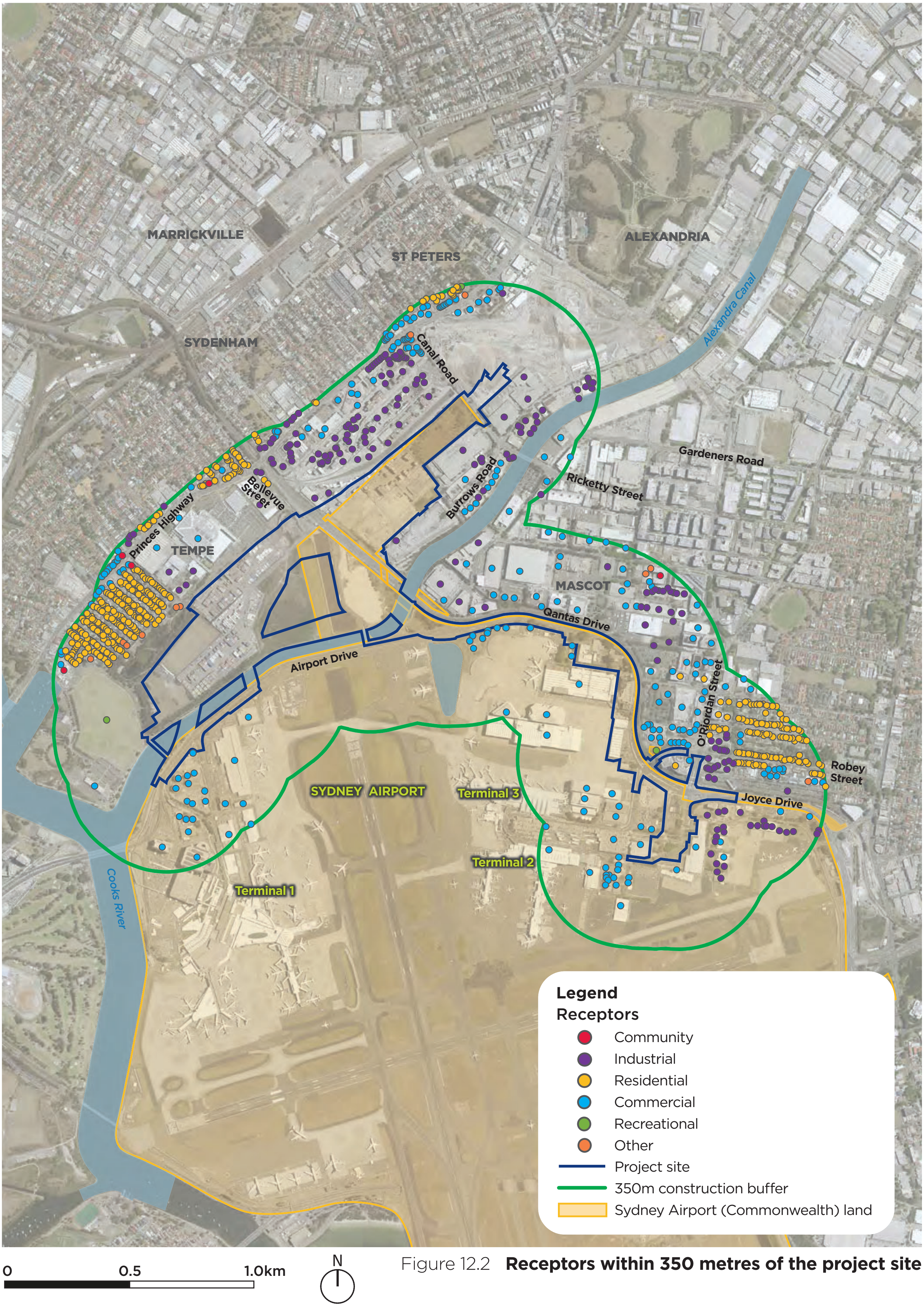

Figure 12.2 **Receptors within 350 metres of the project site**

Odour

Seventeen representative receptors closest to the project site in various directions were selected for the odour assessment (shown on Figure 12.3). If potential odour impacts during construction comply with the assessment criteria at these nearest receptors, then those situated at a greater distance are also likely to comply.

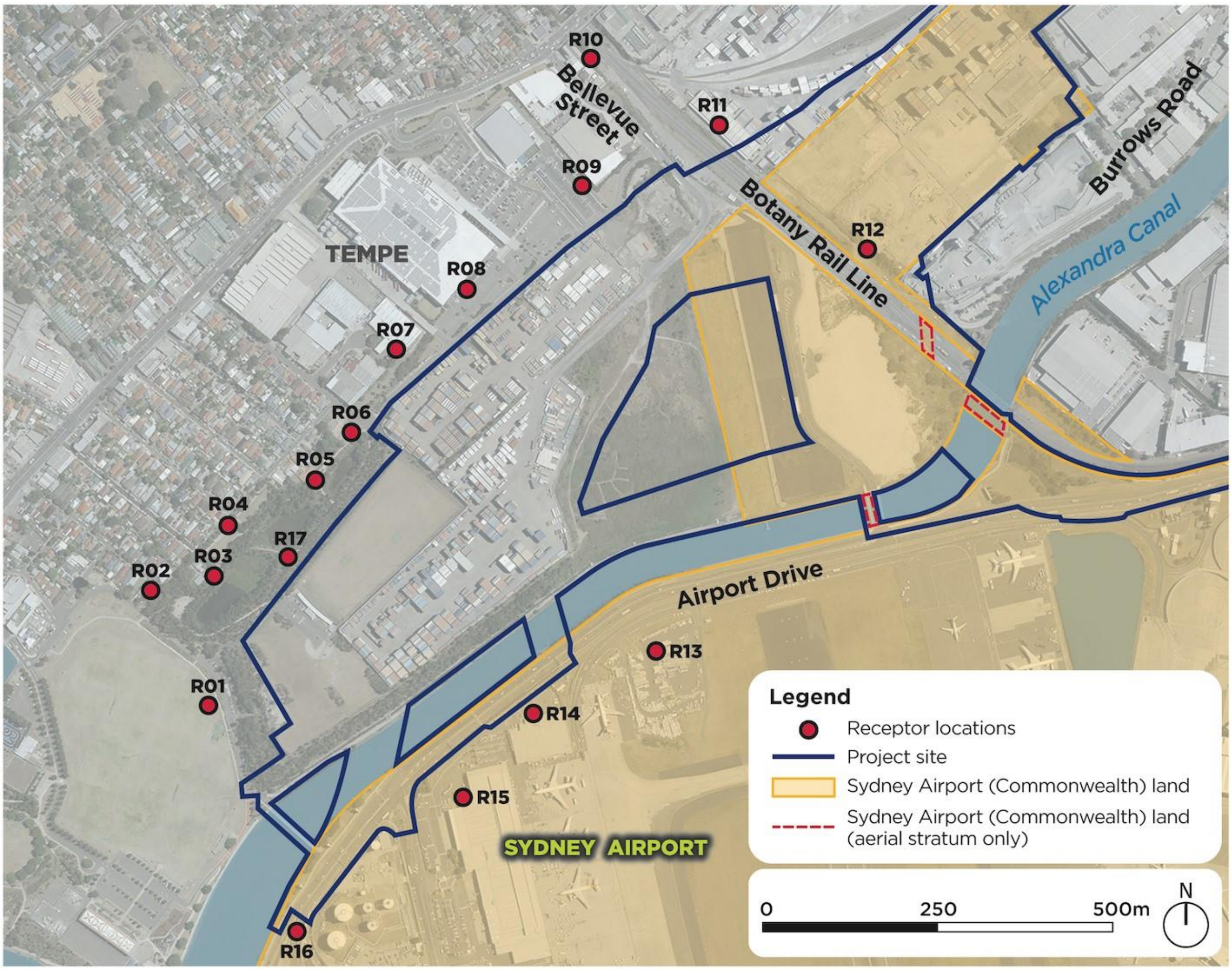

Figure 12.3 Representative receptors for odour assessment

Operation

The operational air quality assessment included consideration of impacts at two types of receptors in the vicinity of the project site and other affected roads:

- Community receptors – these represent particularly sensitive locations, such as schools, child care centres and hospitals. A total of 17 community receptors were considered.
- Residential, workplace and recreational receptors – these represent discrete receptor locations. A total of 12,145 residential, workplace and recreational receptors were considered.

It should be noted that community receptors are a subset of residential, workplace and recreational receptors however they have also been considered separately to ensure a robust assessment is undertaken. Furthermore, any community receptor not specifically identified have still been assessed under the grouping of residential, workplace and recreational receptors.

Figure 12.4 shows the locations of receptors considered by the assessment.

Figure 12.4 **Modelled air quality receptors for operational assessment**

12.4 Assessment of construction impacts

12.4.1 Potential emission sources

Potential emissions sources during construction include:

- Dust from demolition, earthworks, construction works and vehicle movements
- Exhaust emissions from construction plant and equipment
- Odour and landfill gas emissions following removal of sections of the cap at the former Tempe landfill.

12.4.2 Dust generation risk

Construction activities can be categorised into four types to reflect the potential for impacts:

- Demolition – any activity that involves the removal of existing structures
- Earthworks – ground disturbance activities such as soil stripping, ground levelling, excavation and landscaping which involve excavating material, stockpiling, processing excavated material, haulage and tipping
- Construction – any activity that involves providing new structures or modifying existing structures, including buildings and roads
- Track out – the movement of dust and dirt by construction vehicles from a project site onto a public road network.

The risk of dust arising in sufficient quantities to cause annoyance and/or the potential for health and ecological impacts was determined for each activity type by considering the scale and nature of the works and the sensitivity of the area.

The construction dust risk assessment considered both human receptors and areas of ecological significance (see Figure 12.2).

Table 12.3 provides a summary of the results of the construction dust risk assessment. A detailed description of the ratings used is provided in Technical Working Paper 4 (Air Quality).

Table 12.3 Summary of construction dust risk assessment

Activity	Potential for dust emission	Sensitivity of area			Risk of dust impact		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Large	High	High	Medium	High	High	High
Earthworks	Large	High	High	Medium	High	High	Medium
Construction	Large	High	High	Medium	High	High	Medium
Track out	Large	High	High	Medium	High	High	Medium

For all activities, the potential for dust emissions was determined to be large, and the sensitivity of the assessment area for different dust impacts was determined to be high or medium. Based on these factors, the risk of dust impacts was also determined to be high or medium for all construction activities.

Uncontrolled dust generation has the potential to create visibility issues for aviation operations. In addition, impacts from construction and demolition could include the release of asbestos fibres, heavy metals, silica dust or other pollutants during the demolition of buildings, where these buildings contain hazardous materials, or the removal of contaminated soils.

Consequently, management and mitigation measures included in the Construction Air Quality Management Plan (described in section 12.7.1) would be implemented to minimise dust and mitigate the effects of construction on local air quality. Measures relating to the inspection and removal of hazardous materials, should they be present, are regulatory procedures which govern the actions taken to minimise the risk of harm due to release or removal of these materials. Further information on the management of hazardous materials is provided in Chapter 23 (Health, safety and hazards).

With the application of the proposed measures, the risk of dust would be substantially minimised and well managed. The measures are expected to be effective in reducing dust to levels such that dust would not affect aviation safety. Any impacts that the community, nearby receptors and sensitive environments experience would be temporary.

12.4.3 Exhaust emissions

The main source of emissions would be from the combustion of diesel fuel and petrol from heavy vehicles, mobile excavation machinery, and stationary combustion equipment as well as from the handling and/or on-site storage of fuel and other chemicals. The volume of emissions from construction vehicles and machinery would depend on the type of fuel used, the power output and condition of the engine, and duration of operation.

Exhaust emissions would involve periodically localised emissions of carbon monoxide, particular matter (PM_{10} and $PM_{2.5}$), oxides of nitrogen (NO_x), sulfur dioxide, volatile organic compounds, and PAHs associated with the combustion of diesel fuel and petrol.

Exhaust emissions generated during construction would not significantly contribute to emissions in the area, given the existing levels of transport uses. Emissions from construction vehicles and plant would be dispersed along the alignment of the project site and intermittent in nature depending on particular construction activities.

12.4.4 Potential odour impacts from the former Tempe landfill

The project would involve works at the former Tempe landfill with the potential to generate odour. Three sources of odorous emissions were identified and assessed:

- Exposed waste on excavation faces and emplacement areas
- Covered waste areas
- Disturbance and handling of waste (ie from plant and equipment performing waste movement operations).

Specific odour emission rates for each potential odour source were identified using an in-house database of odour emission rates from various putrescible and non-putrescible landfills in NSW. The adopted odour emission rates, as odour units per square metre per second ($OU/m^2/s$), are shown in Table 12.4.

Table 12.4 Adopted odour emission rates

Source	Specific odour emission rate (OU/m2/s)
Exposed waste	1
Covered waste	0.12
Waste disturbance and handling	26

Predicted odour impacts were modelled in accordance with the Approved Methods for two construction scenarios:

- Scenario 1 (worst case) considered the entire area of the proposed excavation emitting odour at the same time
- Scenario 2 (realistic case) considered only a portion of the proposed excavation area (equivalent to about 30 per cent of the total) emitting odour at any one time.

The predicted 99th percentile odour emission concentrations are summarised in Table 12.5. The values bolded red indicate exceedances of the two odour unit criterion.

Table 12.5 Predicted odour concentrations and sensitivity analysis (99th percentile)

Receiver	Receiver type	Scenario 1 (worst case)	Scenario 2 (realistic case)
R01 Tempe Recreation Reserve	Recreational	**2.8**	1.5
R02 2 Station Street, Tempe	Residential	1.5	0.8
R03 South Street, Tempe	Residential	**2.3**	1.4
R04 5 Wentworth Street, Tempe	Residential	1.7	0.9
R05 5 South Street, Tempe	Residential	**2.6**	1.4
R06 2 South Street, Tempe	Vacant lot	**3.3**	1.9
R07 Brissett Rollers	Commercial	**3.1**	1.5
R08 IKEA	Commercial	**4.1**	2.0
R09 Salvos Stores, St Peters	Commercial	**3.7**	1.9
R10 3 Bellevue Street, Tempe	Residential	1.4	0.8
R11 Maritime Container Services	Industrial	1.8	1.0
R12 Boral Recycling	Industrial	0.8	0.5
R13 Sydney Airport	Commercial	**2.4**	1.1
R14 Atlas Air Inc building	Commercial	**3.2**	1.6
R15 Qantas Freight Terminal	Commercial	**2.2**	1.1
R16 C & L Sales & Services	Commercial	1.8	1.0
R17 Tempe Lands	Recreational	**3.5**	**2.1**

The results of the assessment indicate that:

- Exceedances of the odour unit assessment criterion are predicted for scenario 1 (worst case), mainly attributed to the large area of exposed waste assumed in this scenario
- Only one potential exceedance of the odour assessment criterion is predicted for scenario 2 (realistic case). This was at receptor R17 (Tempe Lands).

Based on the desktop analysis, it was concluded that:

- Odour emissions could be managed to within the adopted criterion levels by controlling the amount of exposed waste, including related waste handling and movement activities, to within 30 per cent of the total waste excavation and filling areas
- Any odours would be localised and temporary, following the covering of the waste.

Regardless of these conclusions, a number of mitigation measures are proposed to reduce the potential for odour impacts. The approach to managing the potential for odour impacts is described in section 12.7.

12.4.5 Landfill gas

The breakdown of putrescible waste and organic matter in a landfill generates methane, carbon dioxide and other trace gases (landfill gas) that may pose hazards to site safety, human health and the surrounding environment. While methane and carbon dioxide are odourless, other components of landfill gas, such as hydrogen sulfide and ammonia can be odorous, affecting local amenity. Methane may be explosive if concentrations reach five to 15 per cent by volume in air. Carbon dioxide can be an asphyxiant if sufficient volumes collect in a confined space.

As the project would involve removing sections of the existing cap at the former Tempe landfill, there would be an initial release of any trapped gases resulting in increased odour potential. Following this, specific works that intersect with the waste (such as excavation and piling) may also release any pockets of trapped gas for short periods. Based on previous measurements taken during geotechnical investigations at the site, while methane can be present initially in high concentrations, these rapidly decrease once venting occurs (over a period of hours or days).

Due to the age of the landfill, it is expected that the majority of putrescible waste has degraded. However, there would be ongoing low production of landfill gas from other sources. Works within the site would be undertaken with the assumption that high levels of methane and landfill gas would be present, and appropriate management measures would be put in place. These would include, at a minimum, relevant occupational work, health and safety precautions, measurements of methane concentrations using a gas meter, and restrictions on hot works.

The Sydney Airport northern lands car park area is currently managed in accordance with an environmental management plan, which documents the procedures to be followed during any future works in this area. Construction would be carried out in accordance with this plan. Further information, including relevant mitigation measures, are provided in section 12.7 and Chapter 13 (Contamination and soils). Implementation of the proposed measures are expected to effectively manage potential landfill gas impacts during construction.

12.4.6 Summary of impacts on Sydney Airport (Commonwealth) land

Dust

Figure 12.5 shows the locations of sensitive receptors on Sydney Airport land and within 350 metres of the project site. These receptors are either commercial or industrial.

As noted in section 12.4.2, there is a medium risk (earthworks, construction, track out) and high risk (demolition) of dust impacts on nearby receptors. Uncontrolled dust generation also has the potential to create visibility issues for aviation operations.

Management and mitigation measures from the Construction Air Quality Management Plan (see section 12.7) would be implemented to minimise dust and mitigate the effects of construction on local air quality. With the application of the proposed measures, the risk of dust would be substantially minimised and well managed. The measures are expected to be effective in reducing dust to levels such that dust would not affect aviation safety.

Odour

Five of the 17 receptors included in the odour modelling are located on Sydney Airport land (receptors R12, R13, R14, R15 and R16). The results of the odour modelling (Table 12.5) show that:

- No exceedance of the odour criterion is predicted for scenario 2 (realistic case) at any receptors located on Sydney Airport land
- Exceedances of the criterion are predicted at some receptors on Sydney Airport land for scenario 1 (worst case). These exceedances are mainly attributed to the large area of exposed waste assumed in this scenario.

The proposed approach to managing odour (see section 12.7) would minimise the potential for odour impacts on Sydney Airport land as a result of works at the former Tempe landfill.

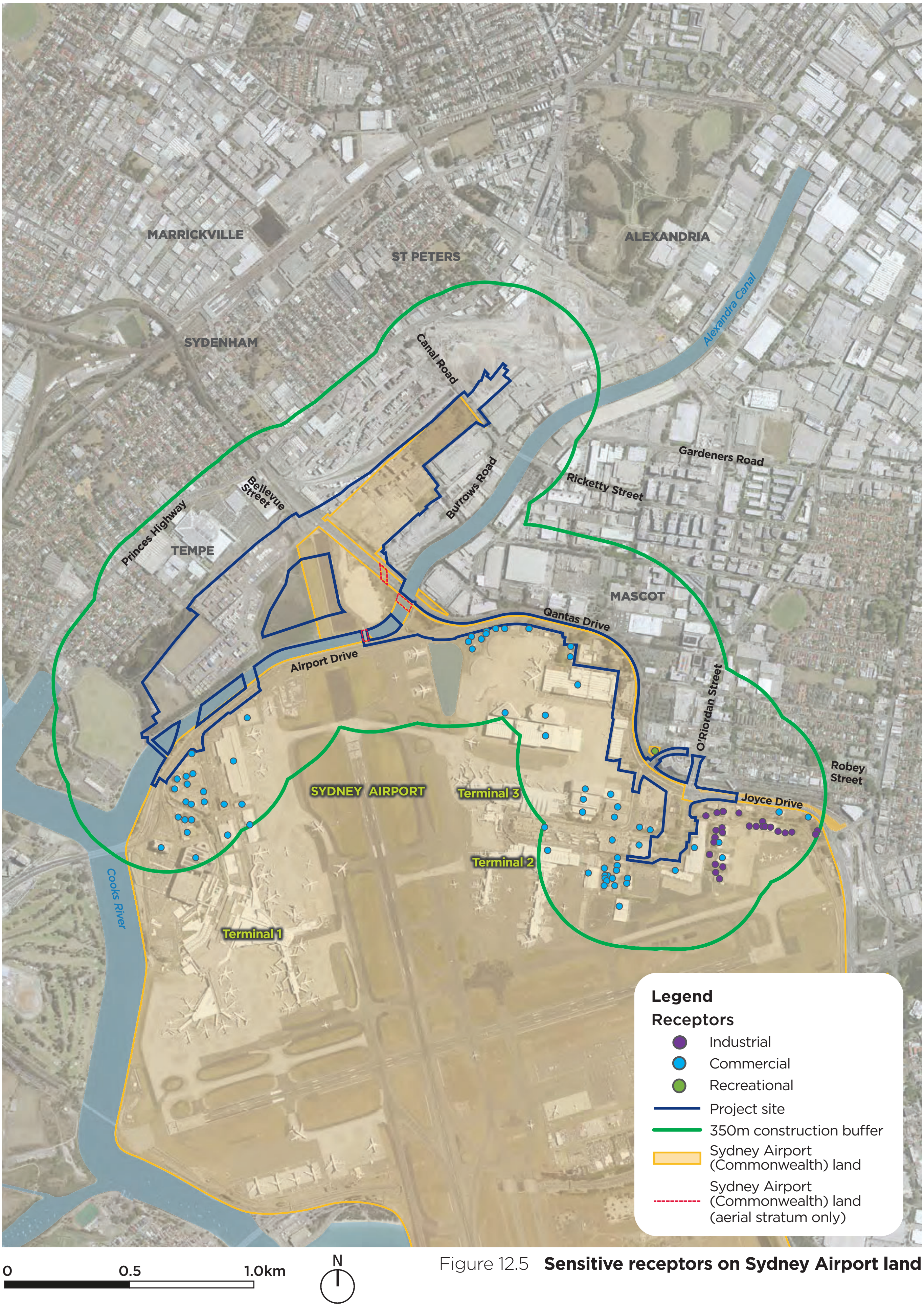

Figure 12.5 **Sensitive receptors on Sydney Airport land**

Exhaust emissions

Exhaust emissions generated during construction would not significantly contribute to emissions on Sydney Airport land, given the existing levels of vehicle use in the study area.

Landfill gas

Works in the Sydney Airport northern lands car park area would be carried out in accordance with the procedures in the existing environmental management plan for this area. Implementation of these procedures is expected to effectively manage potential landfill gas impacts on Sydney Airport land during construction.

12.5 Assessment of operation impacts

12.5.1 Potential emissions

The emissions model estimated emissions for more than 2,000 road links and multiple pollutants for each traffic scenario. A description of each traffic scenario is provided in Table 9.1 (see Chapter 9 (Traffic, transport and access)).

The estimated total emissions for all roads (including tunnels) in the study area are provided in Table 12.6. This shows that in both 2026 and 2036, when comparing the 'with the project' and cumulative scenarios and the 'without the project' scenarios:

- Emissions of CO increased slightly
- Emissions of all other pollutants decreased slightly or stayed broadly the same.

The predicted absolute and percentage changes in emissions are shown in Table 12.7 and Table 12.8, respectively. The results indicate that the overall changes in emissions associated with the project in a given future year (2026 or 2036) would be much smaller than the underlying reductions in emissions from the traffic on the network between 2016 and the scenario year due to improvements in emission-control technology.

For the 'base year' and the 'without the project' scenarios, it can be seen from the results provided in Table 12.8 that between 2016 and 2026, the total emissions of CO, NO_x and THC from traffic on the road network are predicted to decrease by between 45 and 55 per cent. Between 2016 and 2036, the reductions were between 50 and 65 per cent. For PM_{10} and $PM_{2.5}$, the underlying reductions were smaller, at between around 10 and 20 per cent. This is mainly because there is currently no anticipated regulation of non-exhaust particles (such as from tyre and brake wear, road surface wear and resuspension of road dust), which form a substantial fraction of the total.

Table 12.6 Total traffic emissions in the study area

Scenario	Total daily vehicle kilometres travelled (millions)	Total emissions (tonnes/year)				
		CO	NO_x	PM_{10}	$PM_{2.5}$	THC
Base year (2016)	6.3	4,329	2,391	129	90	474
2026 without the project	6.8	2,086	1,338	112	71	218
2026 with the project	6.9	2,093	1,320	111	70	213
2026 cumulative scenario	7.0	2,110	1,326	112	70	213
2036 without the project	7.3	1,596	1,245	118	72	163
2036 with the project	7.5	1,607	1,227	117	72	160
2036 cumulative scenario	7.6	1,636	1,233	118	72	158

Table 12.7 Absolute changes in total traffic emissions in the study area

Scenario comparison	Change in total emissions (tonnes/year)				
	CO	NO_x	PM_{10}	$PM_{2.5}$	THC
Underlying changes in emissions with time					
2026 without the project vs the base year (2016)	-2,244	-1,053	-17	-19	-256
2026 with the project vs the base year (2016)	-2,734	-1,146	-11	-18	-311
Changes due to the project in a given year					
2026 with the project vs without the project	+7.5	-18.2	-0.9	-0.6	-5.1
2026 cumulative scenario vs without the project	+24.5	-12.0	-0.5	-0.3	-5.6
2036 with the project vs without the project	+11.7	-18.7	-0.7	-0.4	-3.0
2036 cumulative scenario vs without the project	+40.0	-12.0	-0.2	-0.1	-5.7

Table 12.8 Percentage changes in total traffic emissions in the study area

Scenario comparison	Change in total emissions (%)				
	CO	NO_x	PM_{10}	$PM_{2.5}$	THC
Underlying changes in emissions with time					
2026 without the project vs the base year (2016)	-51.8%	-44.0%	-12.9%	-21.4%	-53.9%
2026 with the project vs the base year (2016)	-63.1%	-47.9%	-8.4%	-19.5%	-65.6%
Changes due to the project in a given year					
2026 with the project vs without the project	+0.4%	-1.4%	-0.8%	-0.8%	-2.3%
2026 cumulative scenario vs without the project	+1.2%	-0.9%	-0.4%	-0.4%	-2.6%
2036 with the project vs without the project	+0.7%	-1.5%	-0.6%	-0.6%	-1.8%
2036 cumulative scenario vs without the project	+2.5%	-1.0%	-0.2%	-0.1%	-5.7%

12.5.2 Local impacts

A summary of the air quality modelling results is provided below. The overall results for each traffic scenario for all pollutant sources, including concentrations and contour plots, are provided in Technical Working Paper 4 (Air Quality). Overall, the results of the operational air quality modelling showed that:

- The predicted total concentrations of all modelled pollutants at receptors were usually dominated by the existing background contribution, although for NO_2, a significant contribution was predicted to be generated from the modelled road traffic
- For several air quality metrics (notably annual mean $PM_{2.5}$ and 24-hour PM_{10} and $PM_{2.5}$), exceedances of the criteria were predicted to occur both with and without the project. This was because of high background concentrations. In other words, the background levels already exceed the relevant criteria without the project
- Where increases in pollutant concentrations at receptors were predicted, these were mostly small. Only a very small proportion of receptors were predicted to have larger increases and these were near proposed new sections of road.

The modelled spatial changes in air quality as a result of the project are quite complex, reflecting the complex changes in traffic on the network. Key outcomes are predicted to include:

- Marked increases in pollutant concentrations on the new roads associated with the project (Terminal 1 connection, St Peters interchange connection, and the Qantas Drive upgrade and extension)
- Increases in pollutant concentrations on several existing roads (Qantas Drive, Joyce Drive, General Holmes Drive, and Airport Drive near Terminal 1) due to increased traffic
- Decreases in pollutant concentrations along several existing roads (M5 East, Southern Cross Drive, Botany Road, and Canal Road) due to reductions in traffic of between 8 per cent and 28 per cent on these roads
- For the cumulative scenarios (in 2026 and 2036) there were some additional air quality changes associated with the future introduction of the proposed F6 Extension project, including:
  - Further reductions in concentration along Southern Cross Drive and the M5 East
  - A reduction in concentrations along The Grand Parade
  - An increase in concentration along President Avenue.
- For selected odorous pollutants, the change in the maximum 1-hour concentration was an order of magnitude below the corresponding odour assessment criteria in the NSW Approved Methods and should not be perceptible by the community.

A summary of the key findings for specific pollutants is provided below.

Carbon monoxide (maximum 1-hour)

For all receptors and scenarios, the predicted maximum 1-hour CO concentration was well below the assessment criterion of 30 $\mu g/m^3$, as well as the lowest international air quality standard identified in the literature (22 $\mu g/m^3$).

There was an increase in CO at between 40 and 51 per cent of residential, workplace and recreational receptors, although even the largest increases were small compared with the criteria.

Carbon monoxide (maximum rolling 8-hour)

At all receptors the predicted maximum rolling 8-hour CO concentration was well below the NSW impact assessment criterion of 10 $\mu g/m^3$. There are no lower criteria used internationally, as determined from the literature review.

Nitrogen dioxide (annual mean)

At all receptors, the predicted NO_2 concentration was well below the assessment criterion of 62 $\mu g/m^3$. At all receptors the NO_2 concentration was also predicted to be below the EU limit value of 40 $\mu g/m^3$.

The maximum contribution of road traffic in any scenario and at any receptor was 13.4 $\mu g/m^3$.

An increase in the annual mean NO_2 concentration was predicted at between 24 and 43 per cent of receptors, depending on the scenario. While the largest increases in annual NO_2 were around 4 to 5 $\mu g/m^3$, the increase was greater than 1 $\mu g/m^3$ for no more than around one per cent of receptors.

Figure 12.6 shows the change in annual mean NO_2 concentration in 2036 with the project compared to without the project. The green shading represents a decrease in concentration and the purple shading an increase in concentration. Any changes in NO_2 of less than 1 $\mu g/m^3$ are not shown.

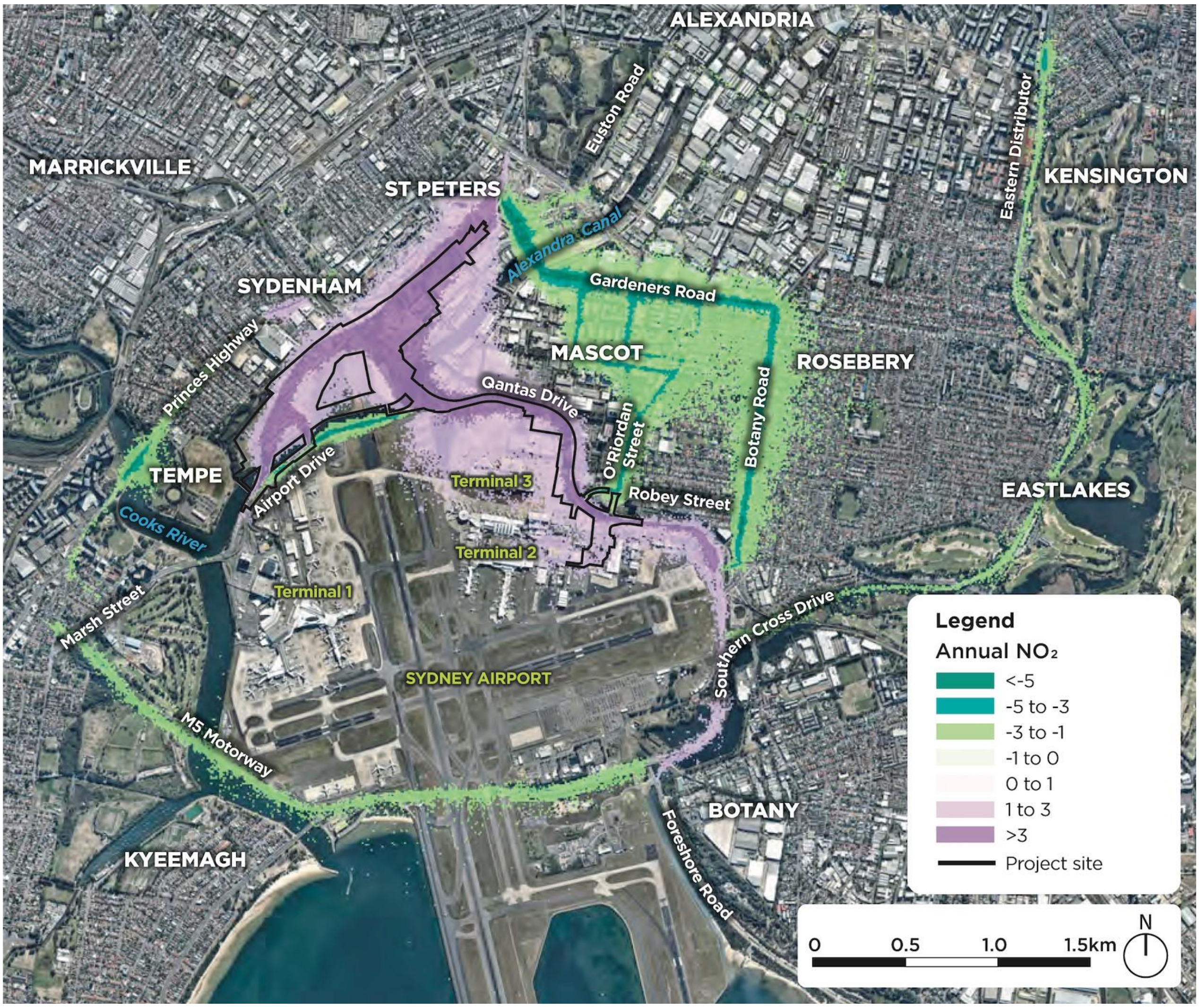

Figure 12.6 Contour plot of change in annual mean NO_2 concentration in 2036

Nitrogen dioxide (maximum 1-hour)

There was only one receptor (out of 12,145) with an exceedance of the NSW 1-hour NO_2 criterion of 246 µg/m^3, and this was not a sensitive location (a car park within Sydney Airport).

An increase in the maximum 1-hour NO_2 concentration was predicted at between 33 and 47 per cent of receptors depending on the scenario. At the majority of receptors, the change was relatively small in all scenarios: for around three to five per cent of all receptors, there was an increase in concentration of less than 5 µg/m^3. At the Sydney Airport receptor mentioned above, there was an increase in the maximum 1- hour NO_2 concentration of 31 µg/m^3 which resulted in an exceedance of the air quality criterion.

The contour plot for the change in the maximum 1-hour NO_2 concentration for 2036 with the project compared to without the project is shown in Figure 12.7.

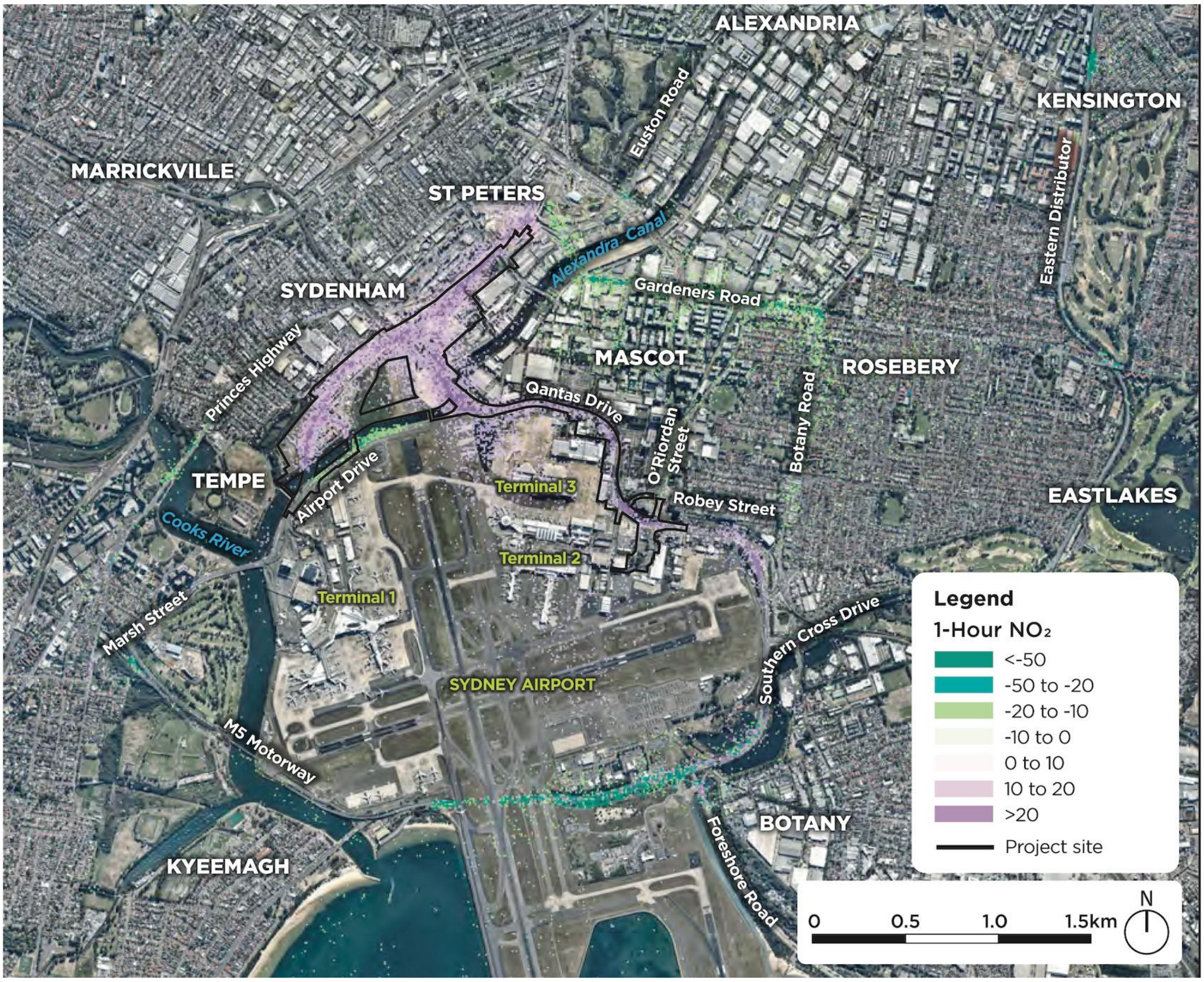

Figure 12.7 Contour plot of change in maximum 1-hour NO_2 concentration in 2036

PM_{10} (annual mean)

The concentration at the vast majority of receptors was predicted to be below 23 µg/m^3, with only two receptors predicted to have a concentration just above the assessment criterion of 25 µg/m^3 in any scenario.

The maximum road traffic contribution in any scenario was 6.9 µg/m^3.

There was an increase in concentration at between 35 and 42 per cent of the receptors, depending on the scenario. At the majority of receptors, the change was relatively small.

The contour plot for the change in the annual mean PM_{10} concentration for 2036 with the project compared to without the project is shown in Figure 12.8.

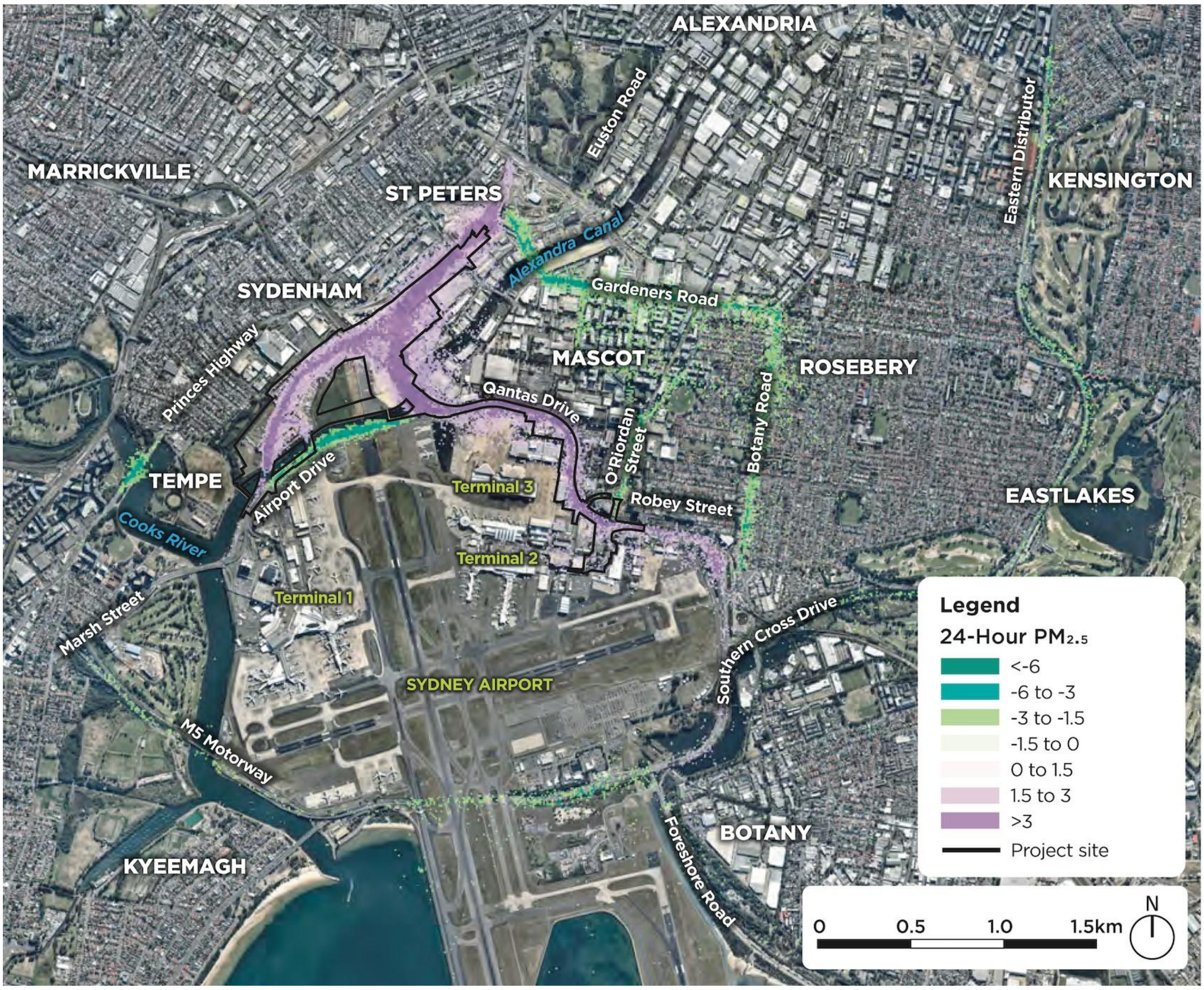

Figure 12.8 Contour plot of change in annual mean PM_{10} concentration in 2036

PM_{10} (maximum 24-hour)

The results for maximum 24-hour PM_{10} were highly dependent on the assumption for the background concentration. Because the background concentration was quite high (56.4 µg/m^3), the total concentration was above the assessment criterion of 50 µg/m^3 at all receptors.

There was an increase in concentration at between 33 and 46 per cent of receptors, depending on the scenario. Where there was an increase, this was greater than 0.5 µg/m^3 (one per cent of the criterion) at seven to ten per cent of receptors, depending on the scenario.

The contour plot of the change in maximum 24-hour PM_{10} for 2036 with the project compared to without the project is shown in Figure 12.9.

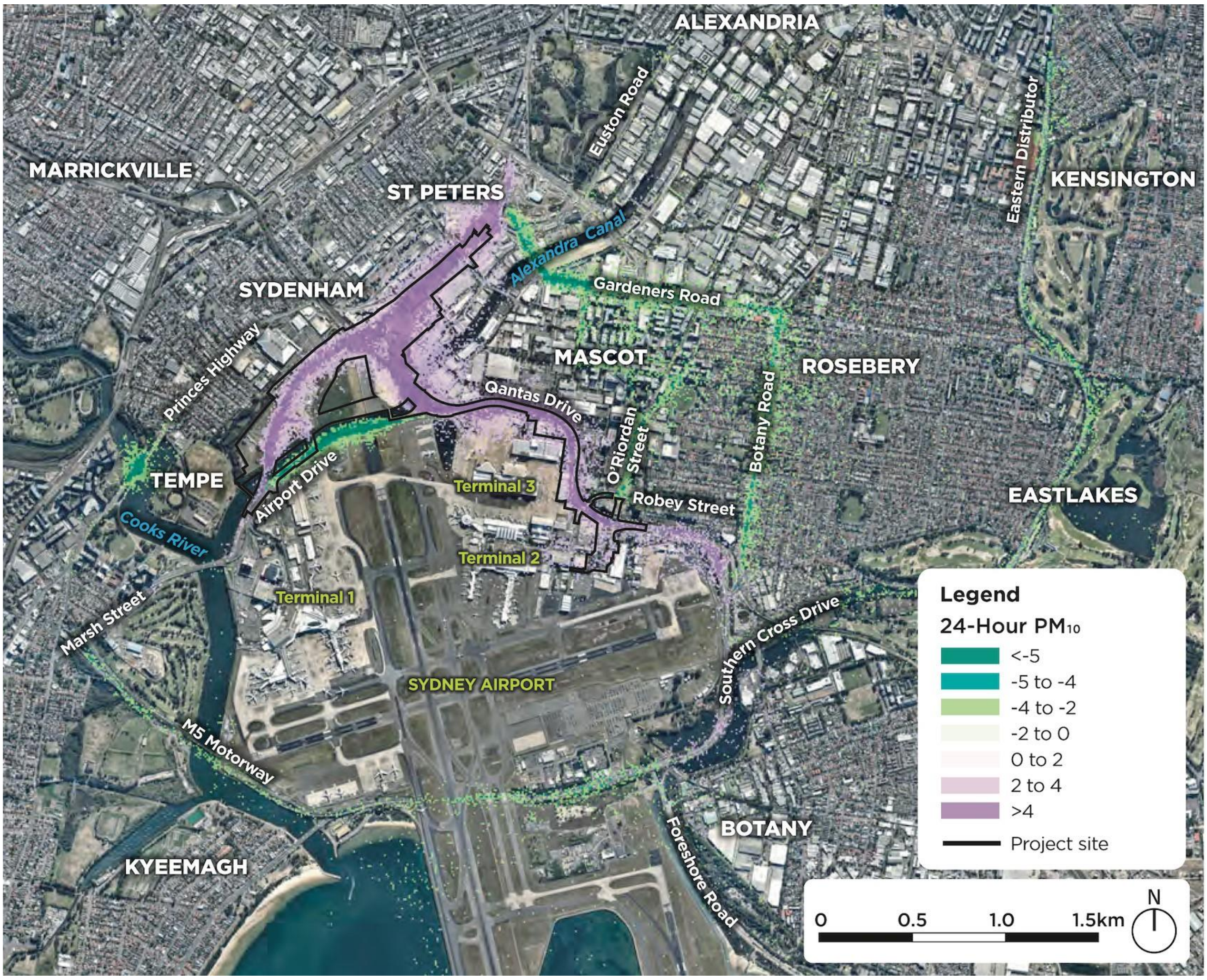

Figure 12.9 Contour plot of change in maximum 24-hour PM_{10} concentration in 2036

$PM_{2.5}$ (annual mean)

The predictions for annual mean $PM_{2.5}$ were highly dependent on the assumptions on background values and based on a mapped background which already exceeded the NSW criterion of 8 µg/m^3 at all receptors. Clearly, there would also be exceedances of the Air NEPM long-term target of 7 µg/m^3. Internationally, there are no standards lower than 8 µg/m^3 for annual mean $PM_{2.5}$.

The highest predicted concentration at any receptor in any scenario was 13.6 µg/m^3. The road traffic contribution was 7.1 µg/m^3.

There was an increase in concentration at between 37 per cent and 44 per cent of receptors, depending on the scenario. Where there was an increase, this was greater than 0.1 µg/m^3 at around two to four per cent of receptors.

No receptor had an increase in annual mean $PM_{2.5}$ that was above the acceptable threshold of 1.8 µg/m^3.

The contour plot of the change in annual mean $PM_{2.5}$ in 2036 with the project compared to without the project is shown in Figure 12.10.

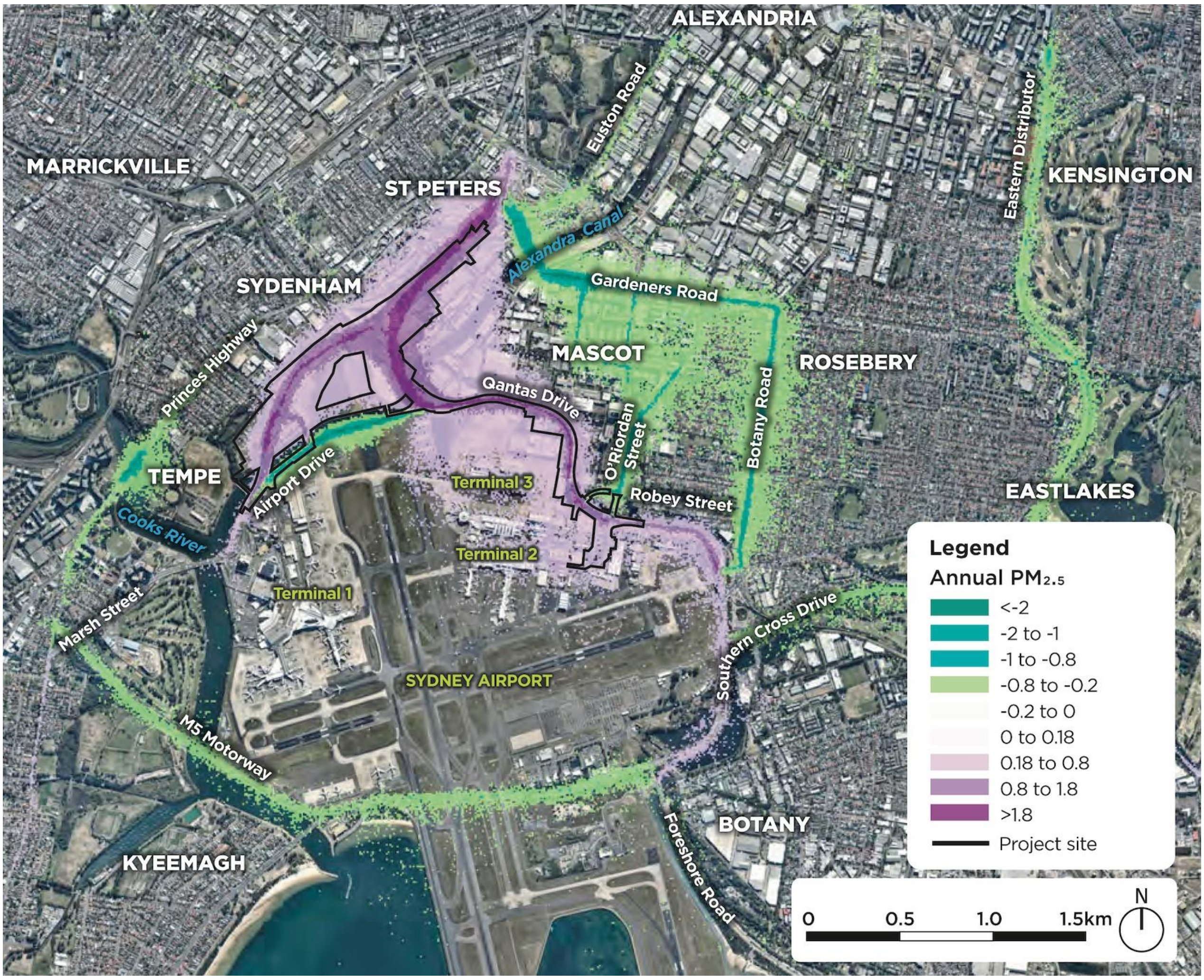

Figure 12.10 Contour plot of change in annual mean $PM_{2.5}$ concentration in 2036

$PM_{2.5}$ (maximum 24-hour)

Given the high background concentration for 24-hour $PM_{2.5}$ (40.9 µg/m^3) in all scenarios, the total concentration at all receptors was above the assessment criterion of 25 µg/m^3.

The largest predicted increase in concentration at any receptor as a result of the project in any scenario was 3.8 µg/m^3. For most of the receptors the change in concentration was small.

The contour plot of the change in maximum 24-hour $PM_{2.5}$ in 2036 with the project compared to without the project is shown in Figure 12.11.

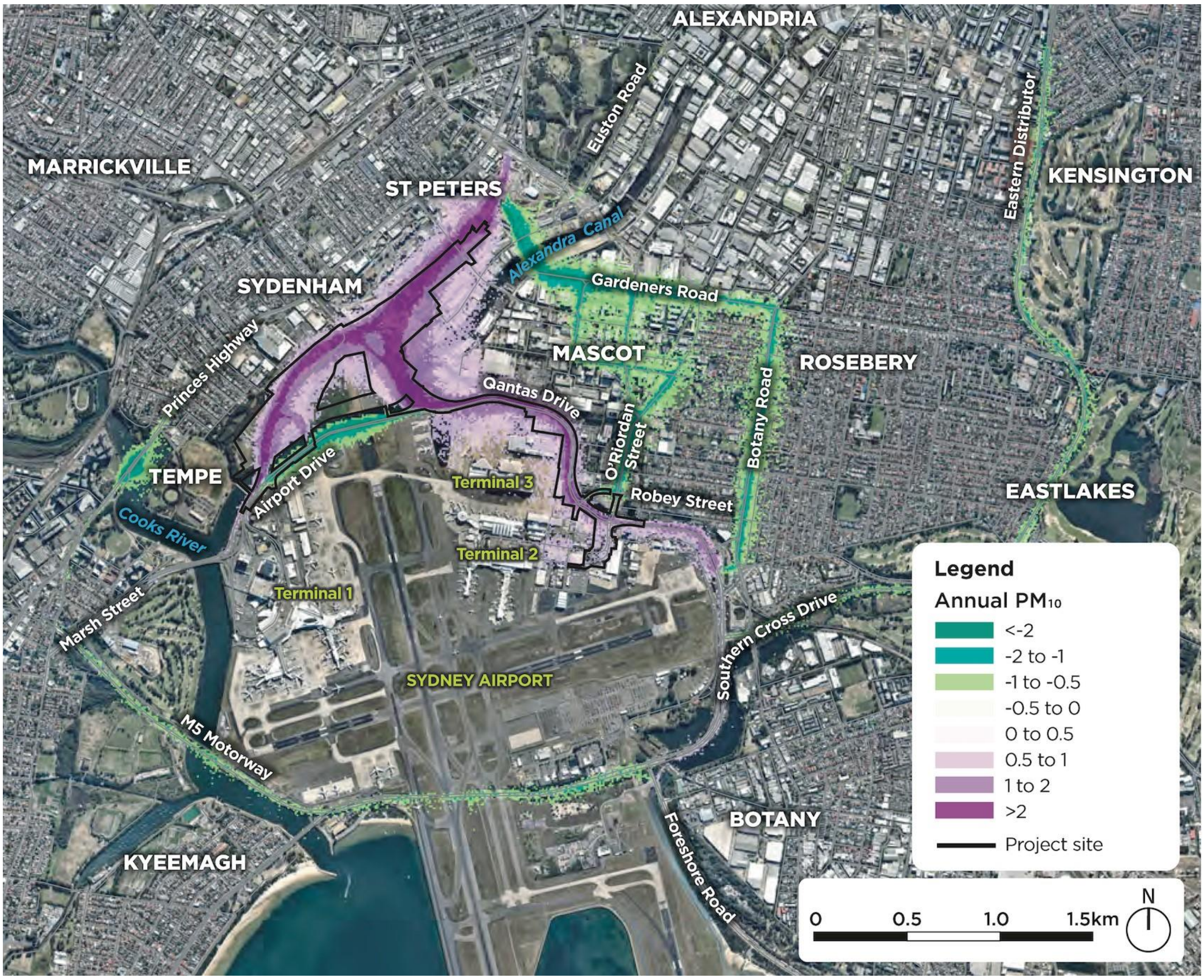

Figure 12.11 Contour plot of change in maximum 24-hour $PM_{2.5}$ concentration in 2036

Air toxics

The changes in the maximum 1-hour concentrations were compared with the relevant assessment criteria. For each compound, where there was an increase in the concentration, this was well below the corresponding assessment criteria.

Odour

The change in the maximum one hour THC concentration as a result of the project was calculated for each of the residential, workplace and recreational receptors. The largest change in the maximum 1-hour THC concentration across all receptors was then determined, and this was converted into an equivalent change for three of the odorous pollutants identified in the Approved Methods (toluene, xylenes and acetaldehyde). These pollutants were taken to be representative of other odorous pollutants from motor vehicles.

As shown in Table 12.9, the predicted change in the maximum 1-hour concentration of each of these odorous pollutants was found to be an order of magnitude below the corresponding odour assessment criteria in the Approved Methods.

Table 12.9 Comparison of changes in odorous pollutant concentrations with criteria in Approved Methods (residential, workplace and recreational receptors)

Scenario	Largest increase in maximum 1-hour THC concentration relative to the without the project scenario (µg/m3)	Largest increase in maximum 1-hour concentration		
		Toluene (µg/m3)	Xylenes (µg/m3)	Acetaldehyde (µg/m3)
Odour criterion (µg/m³)		***360***	***190***	***42***
2026 without the project	56.1	4.1	3.4	0.9
2026 with the project cumulative scenario	50.5	3.7	3.0	0.8
2036 without the project	39.1	2.4	1.9	0.8
2036 with the project cumulative scenario	35.5	2.1	1.8	0.7

In terms of potential odour from works at the former Tempe landfill, once construction works are completed, the working areas would be capped preventing future odour being released through the surface. Therefore, no ongoing operational odour emissions are anticipated.

12.5.3 Landfill gas

The addition of piles and/or services and drainage trenches through the landfill cap and waste may cause the formation of new preferential pathways for gas to escape and flow. However, the low estimated landfill gas production rates of zero to 0.2 litres per hour suggest that an interception mechanism, similar to that currently in place, would be sufficient to limit gas concentrations to less than one per cent methane (by volume) or 1.5 per cent carbon dioxide (by volume), ensuring there would be no adverse impacts from on and offsite migration.

Roads and Maritime would install a gas collection and venting mechanism beneath the capping layer of the road infrastructure and proposed mounds in accordance with the requirements of the *Environmental Guidelines: Solid waste landfills* (EPA, 2016a), to allow landfill gas to be collected and passively vented and minimise the potential for accumulation. The gas collection system would also include appropriate seals around any cap perforations, such as bridge piles or other support structures. This would minimise the presence of preferential pathways along services and drainage trenches and from the infrastructure generally.

In addition, the new landfill capping layer is expected to reduce the potential for landfill gas emissions, and the increased topsoil/vegetation layer across the project site would promote oxidation of landfill gas before emission to the atmosphere.

The existing environmental management plans for the Sydney Airport northern lands carpark area (adjacent to the former Tempe landfill) requires ongoing inspections in the centre of the area to monitor erosion of the cap and the presence of landfill gas. It also documents the requirements for maintaining the gas venting system.

Implementation of the proposed gas collection and venting system along with continued implementation of existing environmental management plans is expected to effectively manage potential landfill gas impacts during operation.

12.5.4 Regional impacts

The changes in the total emissions resulting from the project are described in section 12.5.1. These changes can be viewed as a proxy for the project's regional air quality emissions. Based on this, the potential for regional air quality impacts are likely to be negligible.

The regional air quality impacts of a project can also be considered in terms of its capacity to influence ozone production. EPA has recently developed the Tiered Procedure for Estimating Ground Level Ozone Impacts from Stationary Sources (ENVIRON, 2011). Although this procedure does not relate specifically to road projects, it was applied to the air quality assessment to give an indication of the likely significance of the project's effect on ozone concentrations in the region. The analysis found that the project is predicted to result in a small reduction in ozone concentrations.

Overall, it can be concluded that the regional impacts of the project would be negligible and undetectable in ambient air quality measurements at background locations.

12.5.5 Summary of impacts on Sydney Airport (Commonwealth) land

A total of 162 residential, workplace and recreational receptors are located on Sydney Airport land. However, none of the receptors represent particularly sensitive locations from an air quality perspective.

As described in section 12.5.2, for each pollutant and metric, increases in concentrations are predicted at some receptors and decreases at others, depending on their proximity to new sections of road and changes in the traffic network.

Since most of the proposed main network changes would occur near Sydney Airport land, the increases there would be among the largest determined for the study area. Nevertheless, the predicted increases are within acceptable ranges. The most marked predicted changes in concentration included:

- Increases at the north of the airport, around Terminals 2/3 and to the west of Terminal 1
- Reductions near the existing Airport Drive to the north of Terminal 1.

With the likely advances in vehicle emissions technology that would occur in the future, the potential impacts on Sydney Airport land as a result of changes in traffic emissions due to the project are not considered to be significant.

Continued implementation of the existing environmental management plan together with the proposed installation of the gas collection and venting mechanism beneath the road infrastructure and proposed emplacement mounds, are expected to effectively manage potential ongoing landfill gas impacts on Sydney Airport land.

Consistency with the Sydney Airport Master Plan

Sydney Airport Master Plan 2039 (SACL, 2019a) (the Master Plan) has a number of operational and environment objectives. With respect to air quality, one of the objectives is to continue to improve environmental performance at the airport to protect environmentally significant areas.

A key theme of the airport's Master Plan and Environment Strategy is the commitment to sustainability. All major airports have an effect on the air quality environment due to the nature of their operations, and minimising these impacts is fundamental to operating sustainably.

The assessment of the construction impacts of the project on air quality is consistent with this objective and also the theme of sustainability, in that risks have been assessed and mitigation measures are recommended which take into account human health and amenity, and environmentally significant and sensitive areas. Any impacts would likely be temporary.

Modelling indicates the project would result in predicted increases in the concentrations of air pollutants in at least some areas of Sydney Airport. However, any increases in concentrations are likely to be smaller than future predicted emissions reductions between 2016 and 2036 due to advances in vehicle emissions technology.

12.6 Cumulative impacts

A cumulative assessment was undertaken which considered the cumulative risk of dust impacts from the Botany Rail Duplication project in terms of dust soiling, human health and ecological criteria. The assessment indicated that, without mitigation, identified receivers close to the works areas would be at high risk of experiencing cumulative dust impacts. Mitigation measures have been developed (see section 12.7) to minimise the risk of these impacts, as well as the other construction impacts from the project. Chapter 23 (Health, safety and hazards) considers potential impacts to human health).

There are a number of other major infrastructure projects in close proximity to the project site, including the New M5 and M4-M5 Link. The New M5, which includes works at St Peters interchange including the former Alexandria landfill site, is scheduled to be completed prior to the commencement of the Sydney Gateway road project. The M4-M5 Link is farther away, however would be under construction at the same time as the Sydney Gateway road project for a period of about two years. While the potential for cumulative impacts with the M4-M5 Link are not considered to be high, largely because of the separation distance between the two projects, the measures provided in section 12.7 would address this risk.

With regards to cumulative operational air quality impacts, the operational assessment, summarised in section 12.5.2, considered future road developments in the area, such as the F6 Extension (Stage 1 and subsequent stages), the New M5, the M4-M5 Link and Western Harbour Tunnel and Beaches Link. The latter two projects were considered in the 2036 scenario. Existing major developments, such as at Port Botany and Sydney Airport, were also considered in the operational assessment as part of the review and inclusion of background monitoring results. Therefore, the potential for cumulative air quality impacts during operation has been considered as part of the operational air quality impact assessment, with the exception of potential cumulative impacts from operation of the Botany Rail Duplication (considered below).

The summary of results (see section 12.5.2) notes that, for the cumulative scenarios (2026 and 2036), the operational air quality modelling predicted some additional air quality changes associated with the future introduction of the proposed F6 Extension project, including for $PM_{2.5}$:

- Further reductions in concentration along Southern Cross Drive and the M5 East
- A reduction in concentrations along The Grand Parade
- An increase in concentration along President Avenue.

In relation to the cumulative effects from operation of the Botany Rail Duplication, the predominant pollutant of concern would be $PM_{2.5}$ from the diesel locomotive engines. The level of cumulative impact would depend on the contribution of $PM_{2.5}$ from diesel locomotive engines to background air quality compared to the contribution from other existing sources (particularly vehicle traffic). A review of the annual and maximum 24-hour average concentrations of $PM_{2.5}$ indicated that the most significant component is the background levels of this pollutant, with only a relatively minor contribution from vehicle traffic. It is therefore expected that any additional $PM_{2.5}$ from diesel locomotives would only result in minor increases of an already minor contributor to total $PM_{2.5}$ concentrations.

In addition, the Strategic Motorway Planning Model does not account for any reductions in freight traffic that may result following completion of the Botany Rail Duplication. Given that the main pollutant of concern from these freight vehicles is also $PM_{2.5}$, it is possible that the additional freight transport options provided by the increased rail capacity would result in fewer heavy vehicles using the road corridor. This could result in a reduction in impacts following implementation of the Sydney Gateway road project.

12.7 Management of impacts

12.7.1 Approach

Approach to mitigation and management

The assessment identified that the main potential for air quality impacts would be during construction, when there would be the potential for dust and odour impacts if works are not effectively managed.

In terms of the potential for operation impacts, the project has been designed, as far as practicable, to optimise the throughput and operation of vehicles on the local road network. This includes, for example, optimisation of signalised intersections, minimisation of road gradients, and application of speed limits appropriate to the road geometry. Such approaches would generally reduce fuel consumption and overall emissions on a per vehicle basis.

Approach to managing the key potential impacts identified

Potential air quality impacts during construction, including dust and emissions from construction plant and landfill gas, would be managed in accordance with a project-specific Construction Air Quality Management Plan, which would be implemented as part of the CEMP. The plan would define the processes, responsibilities and management measures that would be implemented to minimise potential impacts on air quality. Further information on the CEMP, including requirements for the Construction Air Quality Management Plan, is provided in Chapter 27 (Approach to environmental management and mitigation).

Detailed design and construction planning would seek to minimise odour impacts at the former Tempe landfill by:

- Minimising the need to expose waste, and/or the area exposed at any one time
- Where there is the potential to generate odour, managing this in accordance with an odour management strategy (see below).

The potential for odour emissions and impacts during construction would depend on the strategy adopted by the contractor for excavation within the former Tempe landfill and the management of excavated materials. The odour management strategy would guide pre-construction odour investigations and identify work methods and management measures to ensure that:

- Significant odour issues are avoided
- Any odour issues are rapidly identified and effectively resolved.

The odour management strategy would involve:

- Odour emission sampling to verify the likely odour emission rates from all potential odour sources
- Updating the odour modelling based on the above information, to confirm the odour impact predictions and to refine the measures needing to be implemented to avoid exceedances of the criterion
- Confirming the proposed work methods and mitigation measures that aim to limit odour at sensitive receptors to no more than the 2 OU criterion
- Confirming the approach and action plan if significant odour issues occur, as well as other complementary procedures and actions in response to odour complaints.

Odour would be monitored by undertaking routine (twice daily) odour surveys. If offensive odour is observed at off-site receptors, odour eliminator sprays (or deodorisers) could be used to provide short-term mitigation. Other measures may also be considered based on the outcomes of the odour management strategy.

The odour management strategy would complement the Construction Air Quality Management Plan.

Approach to managing other impacts

Other mitigation measures are provided in section 12.7.2. Mitigation measures to manage impacts from landfill gas are provided in Chapter 13 (Contamination and soils).

Expected effectiveness

Ambient weather conditions such as wind speed and direction, soil moisture and rainfall or dew would substantially influence the day to day potential for dust generation and also the dispersion of odour during construction. Accordingly, construction personnel would need to routinely observe weather conditions to ensure appropriate mitigation measures are implemented or proposed to be in place when conditions change. The proposed measures for dust control are routinely employed as ‘good practice’ on construction sites in NSW and are therefore expected to be effective in controlling dust generation.

The desktop odour modelling and actions proposed in the odour management strategy would set a solid foundation for obtaining site-specific emissions information and updating the impact predictions, prior to construction commencing. Routine daily odour monitoring would also be conducted to identify potential odour issues and contingency measures would be available to address potential issues, should they occur. If these management measures are adopted and carried out effectively, minimal potential for impacts would be expected.

12.7.2 List of mitigation measures

Measures that will be implemented to address potential air quality impacts are listed in Table 12.10.

Table 12.10 Air quality mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Managing air quality impacts during construction	AQ1	A Construction Air Quality Management Plan will be prepared as part of the CEMP and implemented during construction. The plan will detail processes, responsibilities and measures to manage air quality, odour and landfill gas and minimise the potential for impacts during construction. The plan will include an air quality, odour and landfill gas monitoring program, and will detail the measures that will be implemented to compare the actual performance of construction against the predicted performance. Monitoring will be undertaken for the duration of construction.	Pre-construction, construction
Avoiding odour impacts	AQ2	Odour impacts at the former Tempe landfill will be minimised as far as possible by: ▪ Construction planning to minimise the need to expose waste, and/or the area exposed at any one time ▪ Where there is the potential to generate odour, this will be managed in accordance with the odour management strategy (measure AQ3). Further modelling will be carried out to demonstrate that the proposed excavation methodology for the former Tempe landfill can comply with the 2 OU criterion.	Pre-construction, construction
Monitoring and controlling odour at the former Tempe landfill	AQ3	An odour management strategy will be developed prior to construction and implemented for the duration of works involving ground disturbance at the former Tempe landfill. The strategy will include: ▪ Proposed work methods and mitigation measures that aim to limit odour at sensitive receptors to no more than the 2 OU criterion ▪ Routine observation of weather conditions ▪ Regular odour surveys at receptor locations by appropriately qualified professionals (see AQ4) ▪ Measures to minimise the generation of odour at the end of each work day/shift	Pre-construction, construction

Impact/issue	Ref	Mitigation measure	Timing
		▪ Mechanisms for investigating odour complaints, including conduct of additional odour surveys ▪ Contingency and rectification measures (eg use of deodorisers) should significant odour issues occur at sensitive receivers in the vicinity of the project site.	
	AQ4	Odour surveys will be undertaken at downwind receptors for the duration of works involving ground disturbance at the former Tempe landfill in accordance with *Determination of odorants in ambient air by field inspection* (VDI 3940, 1993). The odour surveys will be undertaken: ▪ Daily, for one hour when works commence, and prior to works completing ▪ If wind conditions drop below three metres per second ▪ If an odour complaint is received. If significant odour issues are observed in the vicinity of sensitive receptors, the contingency and rectification measures defined by the odour management strategy will be implemented (see AQ3).	Construction
Impacts on air quality as a result of demolition	AQ5	Demolition activities, including removal of hazardous building materials, will be planned and carried out in a manner that minimises the potential for dust generation.	Construction
Cumulative dust impacts arising from concurrent construction of the Gateway road project and the Botany Rail Duplication project	AQ6	The detailed construction program will be developed in consultation with the contractors constructing the Botany Rail Duplication project. Consultation will be maintained over the duration of both projects to plan activities in a manner that reduces the potential for air quality-related impacts. Where practicable, activities with a high potential to generate dust will be programmed so that they do not occur at the same time.	Pre-construction, construction

12.7.3 Managing residual impacts

Residual impacts are impacts of the project that may remain after implementation of:

- Design measures to avoid and minimise impacts (see sections 6.4 and 6.5)
- Construction planning and management approaches to avoid and minimise impacts (see sections 6.4 and 6.5)
- Specific measures to mitigate and manage identified potential impacts (see section 12.7.2).

With the application of effective management measures, the residual adverse impacts on air quality during construction activities are considered to be temporary and of an acceptable nature.

Although the project is not expected to result in unacceptable pollutant concentrations at surrounding receptors during operation, concentrations were predicted to increase at some receptors. However, where increases were predicted, these were mostly minor and only a small proportion of receptors were predicted to have larger increase, and these were near proposed new road sections. Therefore, residual impacts as a result of operation of the project are considered to be low and of an acceptable nature.