Air Quality Opportunities and Constraints Report

Proposed Rezoning for Residential Development

Wilton Junction Precinct

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Proposed Rezoning for Residential Development

Wilton Junction Precinct

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Executive Summary

Introduction

SLR Consulting Australia Pty Ltd has been commissioned by Elton Consulting, on behalf of the Wilton Junction Landowners' Group, to undertake a high level Air Quality Opportunities and Constraints Assessment for the proposed Wilton Junction Precinct (the Project).

This report addresses the Director-General's Requirements (DGRs) issued 2 May 2013 which state the following of specific relevance to air quality:

- Undertake an assessment for the Wilton Junction Precinct that includes recommended strategies that will be implemented to improve or maintain air quality to ensure National Environmental Protection Measures for ambient air quality are not compromised, in consultation with the NSW Environment Protection Authority (EPA).
- Identify strategies at a local level to ensure air emissions do not cause adverse impact upon human health, the environment and community amenity.

A comprehensive consultation process has been carried out with the EPA and the Office of Environment and Heritage (OEH) in the preparation of this report.

Study Scope

The scope of this study is limited to a high level risk-based (qualitative) assessment the purpose of which is to identify potential opportunities and constraints associated with the development with respect to air quality, and identify any constraints from existing and proposed sources of emissions to air from local industry and commerce proximate to the subject land.

Regional Air Quality and Implications for the Project

Previous air quality studies have shown that ozone is a key atmospheric pollutant of concern during the summer months in Greater Sydney and exceedances of ozone standards tend to occur more frequently in south-western Sydney although emissions of ozone precursors such as oxides of nitrogen and volatile organic compounds from elsewhere within the Sydney airshed contribute to these elevated levels.

Given this information, developments planned for south-western Sydney are required to take action to reduce the levels of precursor pollutants which they emit.

It is noted that the transportation of ozone and air pollution with the north-east sea breeze is anticipated to be less effective with distance south-west, particularly given the reasonably steep terrain existing between Campbelltown and Wilton. It is also expected that at night, cold air drainage down the southern highlands would generally flush the Wilton area with clean air from further south-west, providing improved air quality (SKM 2000).

Existing Local Environment and Sensitive Receptors

Air quality monitoring results measured at Bargo and Macarthur air quality monitoring station over the last 5 years (1 January 2007 to 31 December 2012) indicate that levels of ozone and particulate are potential air pollutants of concern in the Wilton local area, while levels of nitrogen dioxide, sulphur dioxide and carbon monoxide are shown to be considerably less than their respective air quality guideline values for all years.

Residential land uses are planned for a number of areas within the Project site. Sensitive receptors other than residential will include hospitals, schools, parks and other recreational land uses, retail/commercial land uses as well as industries sensitive to changes in air quality.

Executive Summary

Identified Sources of Air Pollution

The following sources have the potential to influence the background air quality within the Wollondilly Local Government Area:

- Mobile sources, including on-road motor vehicles (particularly those using the Hume Highway), off-road motor vehicles, and light aircraft.
- Major industrial sources such as coal seam methane gas power stations, underground coal mining operations, cement manufacturers and poultry farms.
- Light industrial sources such as refuelling stations, drycleaners, and automobile repairers.
- Local infrastructure sources including sewage treatment plants and sewage pumping stations.
- Domestic sources such as lawn mowing and wood heaters.

Construction Phase of the Project

- Worker transportation, plant and machinery.
- Site preparatory works, construction works and workshop activities.
- Storage and transfer of diesel and other fuels.

Operational Phase of the Project

- Traffic and transport, particularly along the Hume Highway and Picton Road.
- Construction and operation of the Maldon-Dombarton Rail Line.
- Operation of the existing (or upgraded) Bingara Gorge Sewage Treatment Plant, the proposed Wastewater Treatment Plant and all associated Sewage Pumping Stations.
- Sydney-Moomba gas pipeline.
- Light industry/commercial operations (i.e. printers, drycleaners, petrol refilling stations, automobile repair, etc).
- Domestic and commercial lawn mowing and surface coatings.
- Use of domestic wood heaters, particularly in the winter months.

Impact Assessment Methodology

Existing industrial sources of air pollutants both within and surrounding the subject land have been identified through review of publicly available information (i.e. Environment Protection Licencing details, National Pollutant Inventory database information, and Environmental Impact Assessment documentation). Air polluting industries likely to make up part of the Wilton Junction Precinct were also identified in consultation with Elton Consulting. For each industry, a *qualitative* risk-based impact assessment was undertaken of potential air quality impacts to identify a range of suitable control measures available to mitigate those impacts.

The assessment takes into account prevailing wind conditions and compliance with relevant separation distances as recommended by the Victorian Environment Protection Authority (in lieu of relevant NSW guidance) in those cases where amenity may be reduced for sensitive or incompatible land uses. Level 1 Odour Impact Assessments have also been undertaken as a "screening assessment" to determine if the surrounding poultry farms meet buffer distance requirements.

Executive Summary

Impact Assessment Results

It has been determined that the existing and proposed surrounding industries will not form a significant constraint on the development in terms of air quality, where suitable mitigation strategies are implemented.

Key issues identified for the construction and operational phases of the Project are provided in the table below along with corresponding mitigation strategies proposed for maintenance of ambient air quality amenity. A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies.

Key Issues and Proposed Mitigation Strategies

Key Issues	Proposed Mitigation Strategy
Construction activities to be located within 10 metres of sensitive receptors.	- Implementation of best practice dust control measures - Locate fixed plant and fuel tanks away from receptors - Compliance with a Construction Environmental Management Plan (CEMP) - Complaints handling and proactive response measures
Increased traffic volumes (particularly on the Hume Highway and Picton Road) predicted for 2021 as a result of the development.	- Traffic/transport initiatives - Road improvements - Setbacks for development - Vegetated buffer placement - Location of sensitive receptors away from busy roads (i.e. the Hume Highway and Picton Road)
Early operations of the Bingara Gorge Sewage Treatment Plant (STP), the proposed Project Wastewater Treatment Plant (WWTP) and associated Sewage Pumping Stations.	- Odour dispersion modelling (STP and WWTP) - Appropriate design and containment - Provision of suitable buffer zones based on the results of odour dispersion modelling - Vegetated buffer placement - Complaints handling and proactive response measures

Closure

Industries and other potential sources of air pollutants which may form a constraint on the proposed development have been identified in accordance with the DGRs. For each identified source, a qualitative risk-based impact assessment has been undertaken of the potential air quality impacts to identify a suitable range of mitigation strategies which may be applied at the local level for maintenance of ambient air quality amenity. The mitigation measures provided reflect the objectives of key air quality policy and legislation including the NSW Government's *Action for Air* policy, the Protection of the Environment Operations Act 1997 and associated Clean Air Regulation 2010, and relevant EPA guidance.

It is noted that the broad "risk-based" approach adopted for this assessment is designed to provide a conservative overall impact risk, and is not the defining determination for the requirement for mitigation and control.

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Elton Consulting, on behalf of the Wilton Junction Landowners' Group, to undertake a high level Air Quality Opportunities and Constraints Assessment for the proposed Wilton Junction Precinct.

1.1 Study Scope

The scope of this study is limited to a high level risk-based (qualitative) assessment the purpose of which is to identify potential opportunities and constraints associated with the development with respect to air quality, and identify any constraints from existing and proposed sources of emissions to air from local industry and commerce proximate to the subject land.

Regional air quality influences are briefly discussed to provide context to this air quality study. Recommendations provided in this report focus on air quality control and mitigation strategies that may be applied at a local level, to ensure that the proposed development does not constitute a significant impact upon air quality in the local area. These proposed strategies will ideally be applied through a redraft of the Master Plan or via the Development Application (DA) stages of the residential subdivision.

This approach is considered appropriate for a high level study. No air quality monitoring or modelling has been undertaken as part of this assessment.

Consultation with the Environment Protection Authority (EPA) and the Office of Environment and Heritage (OEH) involved two face-to-face meetings, and discussion of reporting requirements, key air quality issues, and consideration of mitigation strategies at both a regional and local level.

1.2 Objectives

The objectives of the study are to:

- Investigate and identify any existing, proposed or likely to be proposed sources of emissions to air proximate to the subject land.
- Investigate the potential implications of sources of air pollutant emissions for the staging of the development of the land.
- Recommend management strategies to maximise development opportunities both under the existing situation and into the future.
- Make recommendations for controlling impacts from local air pollutant generating activities in proposed residential areas and associated land uses.

1.3 Previous Studies

There have been a number of previous studies regarding air quality and land use planning in the area of the subject land, including:

- Sinclair Knight Merz (SKM), Proposed Residential Subdivision at Condell Park, Wilton - Air Quality Assessment (Final), December 2000.
- SKM, Proposed Wilton Residential Development - Air Quality Study, July 2002.Statement of Environmental Effects, STP and Effluent Reuse Scheme – Wilton Parklands Development (2005).

These studies have been referenced in **Section 5.1.1** and **Section 6**. Specific air quality terminology is used within this assessment. An explanation of common air quality terms is included as **Appendix A**.

2 PROJECT OVERVIEW

2.1 Project Background

In November 2011, the NSW Government initiated the Potential Housing Opportunities Program and invited landowners with suitably located substantial landholdings to nominate sites which might be able to deliver additional housing to address Sydney's housing supply shortfall. Walker Corporation, Governors Hill, Bradcorp and Lend Lease responded to the Program and nominated landholdings of more than 100 hectares (ha) in Wollondilly Shire, surrounding the Hume Highway-Picton Road intersection for consideration. This area has subsequently become known as Wilton Junction, and is the subject of this application.

Following a Wollondilly Shire Council resolution in May 2012, the four major landowners (collectively known as the Wilton Junction Landowners' Group) signed an agreement to work cooperatively with Council to prepare a high level Master Plan for Wilton Junction to deliver high quality new housing, jobs close to homes, supporting social and utilities infrastructure and services, and a range of complementary land uses.

A high level Master Plan and a Preliminary Infrastructure Requirements Report were considered by the Council on 17 December 2012, with Council resolving to give in-principle support to the proposal. Council also resolved to request that the rezoning be a state-driven process.

Subsequently, the NSW Government decided to coordinate the statutory planning process, led by the Department of Planning and Infrastructure (now the Department of Planning and Environment, DP&E). The Minister for Planning and Infrastructure (now the Minister for Planning and Environment) proposed to prepare a State Environmental Planning Policy (SEPP), as per Section 24 of the Environmental Planning and Assessment Act 1979 (EP&A Act), which identifies that a SEPP is an Environmental Planning Instrument, and Section 37 of the EP&A Act, which relates to the making of a SEPP for State or regional significant development. This was done with a view to rezone the land through an amendment to the Wollondilly Local Environmental Plan 2011 (LEP) to facilitate the early delivery of housing and infrastructure, linked to an agreed Infrastructure, Servicing and Staging Plan.

The Department of Planning and Infrastructure issued Key Study Requirements (KSRs) to the Proponents (Walker Corporation, Bradcorp and Governors Hill) to guide the planning investigations for a new town at Wilton Junction. The KSRs set the criteria for carrying out environmental investigations across the Study Area (excluding both Bingara Gorge and the existing Wilton village which will not be affected by any proposed amendments to their current zoning and planning provisions). The investigations examine the potential for the Wilton Junction Study Area to be rezoned under a SEPP.

The following report addresses Item 9 of the DGRs which state the following in relation to air quality:

- Undertake an assessment for the Wilton Junction Precinct that includes recommended strategies that will be implemented to improve or maintain air quality to ensure National Environmental Protection Measures for ambient air quality are not compromised, in consultation with the EPA.
- Identify strategies at a local level to ensure air emissions do not cause adverse impact upon human health, the environment and community amenity.

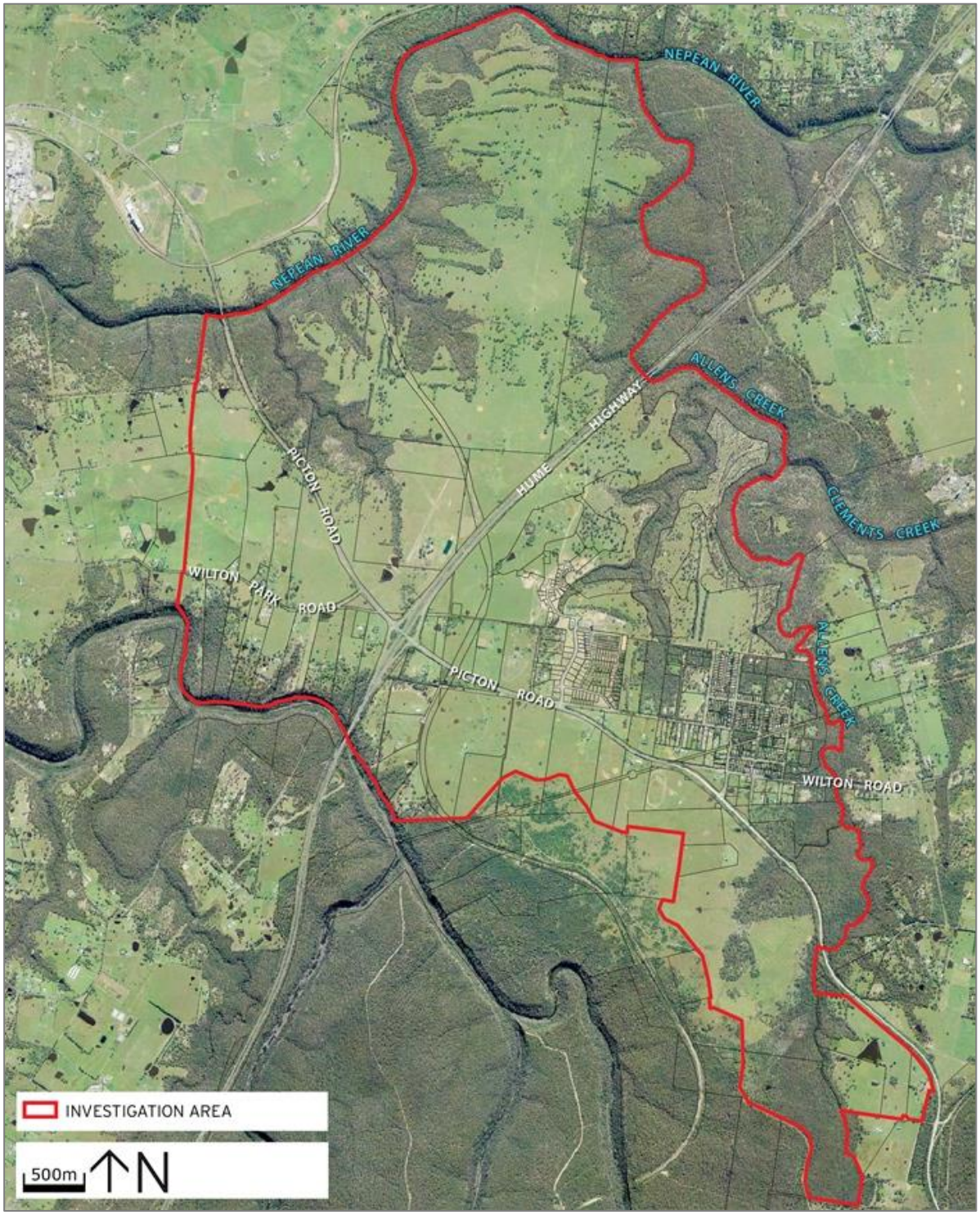
An involved consultation process with the EPA and the OEH has been carried out in the preparation of this report.

2.2 Study Area

Wilton Junction is located within Wollondilly Shire Council and is approximately 80km from Sydney Central Business District, and 30km west of Wollongong. The study area includes the existing village of Wilton and the recently approved suburb of Bingara Gorge (see **Figure 1**).

The area is strategically located around the Hume Highway-Picton Road interchange, and represents the next potential major town along this transport corridor south of Campbelltown–Macarthur. Moreover, Wilton Junction has the distinct advantage of a consolidated land ownership of more than 2,700 ha in the control of recognised developers, with the resources and capability to expedite housing delivery, roll out enabling infrastructure, deliver social services and provide local employment.

Figure 1 Study Area



Source: Elton Consulting

2.3 Land Ownership

There are four major landowners within the Investigation Study Area:

- Bradcorp Pty Ltd (land at Wilton West);
- Walker Corporation (lands south of Picton Road and east of the Hume Highway);
- Governors Hill (land including the Wilton Aerodrome and lands on both sides of Picton Road west of the Hume Highway); and
- Lend Lease (land to the north-west of the Hume Highway-Picton Road intersection; but is excluded from the study requirements).

The Investigation Study Area also includes land by other private owners (excluding land in Bingara Gorge and Wilton village) as outlined in the **Table 1** below, with a plan of the extent of ownership being provided in **Figure 2** below.

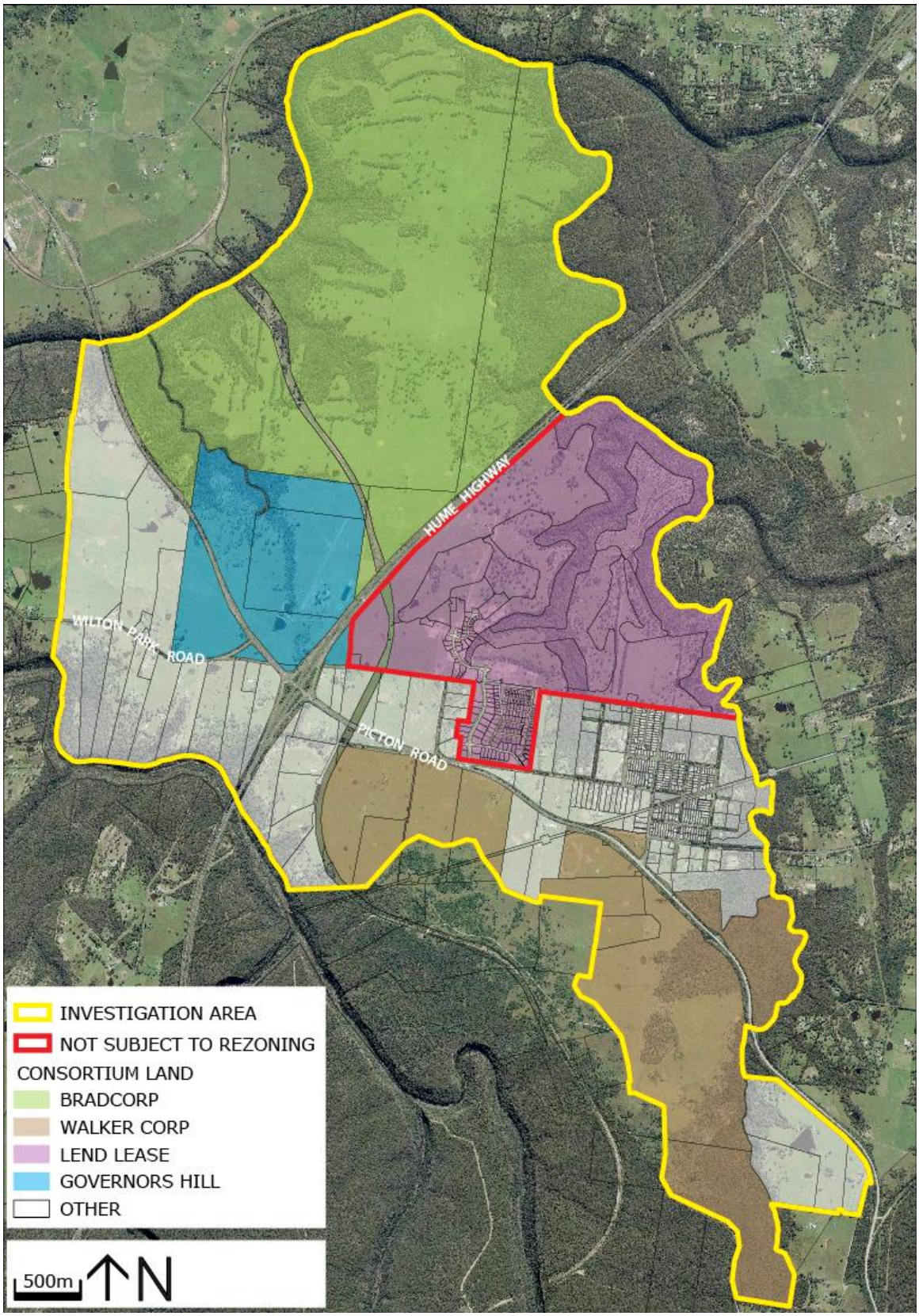
Table 1 Land Ownership

Landowner	Gross Area (ha)	Net Developable Area (ha)
Lend Lease	455	240
Bradcorp	872.4	458.7
Governors Hill	175.3	123.5
Walker Corporation	405.2	230.3
Other landowners**	572.3	489.2
TOTALS	2480.2	1541.7

** This comprises 113 other private landowners, excluding the new Bingara Gorge estate and the existing Wilton village which will not be affected by any proposed amendments to the existing Wollondilly Shire Council planning provisions.

For the purposes of this rezoning application, the Proponents include Walker Corporation, Governors Hill and Bradcorp. Lend Lease will continue with the planning and delivery of its Bingara Gorge community in Wilton, which is already zoned for residential development. Lend Lease is working with the Proponents of this rezoning application to plan and deliver the new town at Wilton Junction and its associated infrastructure.

Figure 2 Land Ownership



Source: Elton Consulting

2.4 Vision for Wilton Junction

The Proponents have a vision for the proposed rezoning of land at Wilton Junction, which is:

Wilton Junction is a new community cradled in a unique landscape characterised by bushland, rivers, creeks, lakes and ridges set against the backdrop of the Razorback Range. By design, the place and the lives of its people are intertwined with the bush.

The community respects the location's rich bushland setting, engages with surrounding water features and embraces sustainability.

Inclusive and welcoming of diversity, it's a place to nurture relationships, grow a family - to put down roots.

Founded on a 21st century interpretation of timeless "Garden City" principles, Wilton Junction combines the best features of our most loved country towns with the facilities, services and technologies found in Australia's most successful, edgy, and vibrant town centres.

A safe place to visit – a healthy place to live – a great place to learn - a rewarding place to work – the local community takes pride in the strength of its cultural and civic life and the role of their town in Wollondilly Shire and the region.

2.5 Project Description

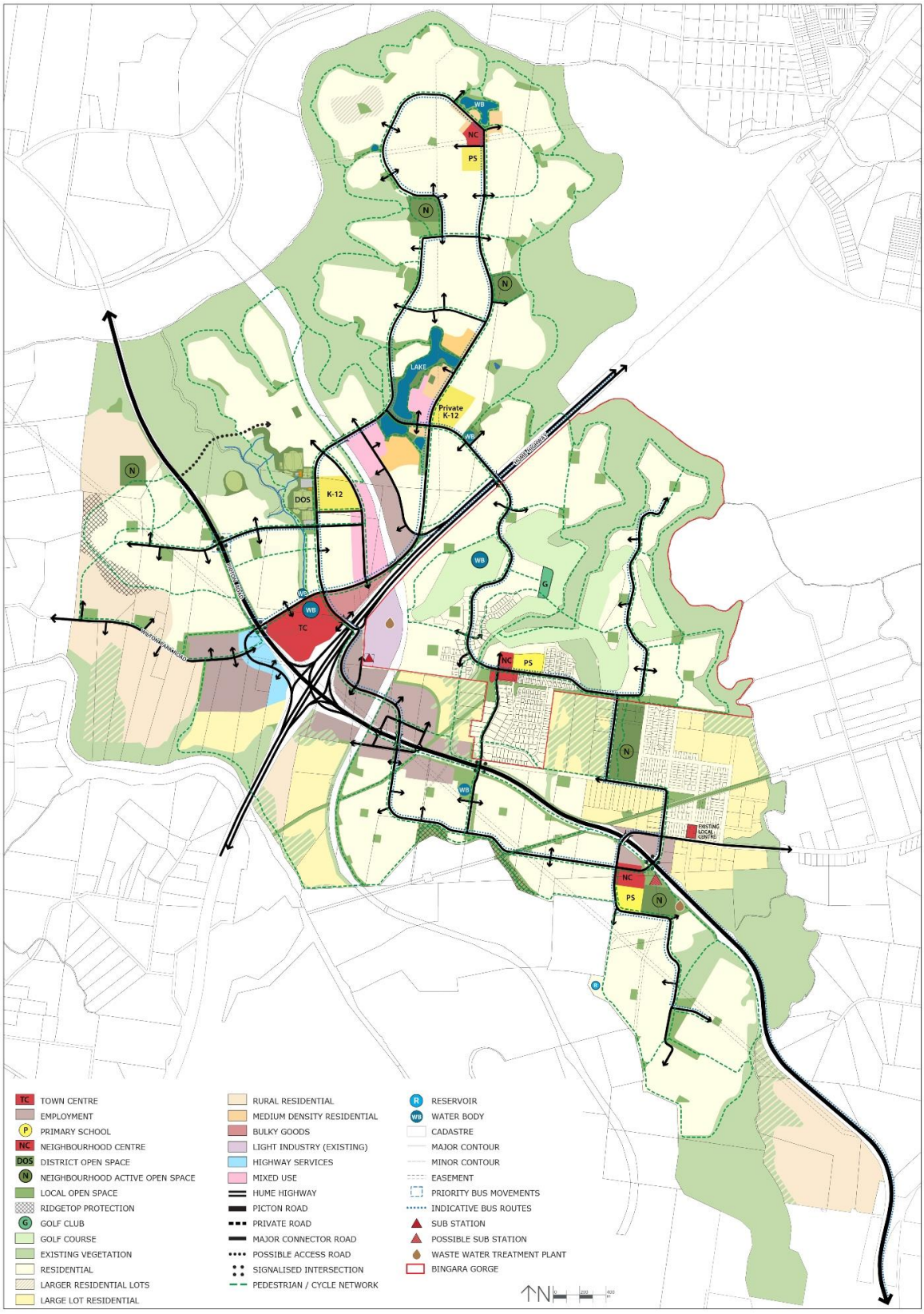
This vision will be delivered through the creation of a new town with between 11,000 and 13,000 new homes and 11,000 jobs. Residential neighbourhoods will be created around green spaces providing a range of housing choice and facilitating healthy lifestyles options for all new residents. A new town, comprising of approximately 17 ha, will be established within the north-west quadrant of the study area (see **Figure 3**) and will be surrounded by employment generating uses for business, bulky goods and light industry, comprising of approximately 120 – 130 ha of land. Smaller neighbourhood centres will be created within the residential neighbourhoods to cater for convenient daily shopping choices. Community facilities and physical infrastructure will be provided facilitating the creation of a self-sustaining community. Existing significant environmental features and heritage items will be preserved commemorating the natural and historical setting of the study area.

This report forms part of the studies required to be undertaken to meet the Director Generals' Key Study Requirements outlined by the Department of Planning and Infrastructure as part of the investigations for the release and rezoning of land at the junction of the Hume Highway and Picton Road through a SEPP. The study outcomes and report has also informed the development and preparation of a Master Plan for Wilton Junction.

The proposed Master Plan will also be informed by the following key principles:

- **Employment and commercial drivers.** The delivery of approximately 11,000 jobs focused around a new town centre and in close proximity to the Hume Highway and Picton Road.
- **Housing.** Providing between 11,000 and 13,000 new dwellings across the precinct, inclusive of the 1,165 already approved at Bingara Gorge and the existing Wilton village.
- **Community facilities**. Provide a diverse range of high quality community facilities including a schools, library, community centre in a town centre and three neighbourhood centres across the precinct.
- **Environment**. Conserving ecological features and biodiversity and establishing a Trust to rehabilitate and manage approximately 614.5ha of bushland.
- **Place making.** Delivering high quality and connected network of streets, spaces and squares throughout the development.
- **Activity centres**. Focus on the delivery of a new town centre and three smaller neighbourhood centres with a diverse mix of retail, commerce, business and light industry.
- **Traffic and transport.** Providing strategic motorway and bus access to surrounding areas, legible movement throughout the development.
- **Infrastructure.** Integrated water, waste water and stormwater management systems and access to all other utilities including gas and NBN.

Figure 3 The Wilton Junction Master Plan



Source: Connor Holmes / Elton Consulting

3 OVERVIEW OF KEY POLLUTANTS

A general overview of key pollutants associated with the Project is provided below.

3.1 Ozone (O_3)

Ozone (O_3) is a key atmospheric pollutant. It has a sharp odour and is a powerful oxidant (i.e. it is highly reactive) which makes it a potent respiratory hazard and pollutant near ground level. Ozone is produced relatively slowly over several hours as a product of the photochemical reaction of ozone precursors including oxides of nitrogen (NO_X) and volatile organic compounds (VOCs) in the presence of sunlight.

Elevated levels of ozone are associated with increases in mortality, hospital admissions, respiratory symptoms, and decreases in lung function. Studies in Sydney have demonstrated associations between ozone and mortality, and ozone and lung function, especially among susceptible sub-groups, such as asthmatics.

3.2 Oxides of Nitrogen (NO_X)

Oxides of nitrogen (NO_X) is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry NO_X generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2).

NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease. The oxidation of NO to NO_2 may also produce ozone (O_3) as a secondary pollutant.

NO_X is emitted by motor vehicles, coal-fired power plants, and other combustion sources. In Sydney, the largest source of NO_X is on-road vehicles, which contribute over 71% of total NO_X emissions. NO is converted to NO_2 soon after leaving a car exhaust. In the presence of sunlight, NO_X reacts photochemically with VOCs to form photochemical smog.

3.3 Volatile Organic Compounds (VOC)

Volatile Organic Compounds (VOCs) are organic compounds (i.e. contain carbon) that have high vapour pressure at normal room-temperature conditions. Their high vapour pressure leads to evaporation from liquid or solid form and emission release to the atmosphere. Impacts due to emissions of VOCs can be health or nuisance (odour) related.

VOCs are emitted by a variety of sources, including motor vehicles, chemical plants, automobile repair services, painting/printing industries, and rubber/plastics industries. VOCs that are often typical of these sources include benzene, cyclohexane, ethylbenzene, toluene and xylenes. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels. Biogenic (natural) sources of VOC emissions are also significant (e.g. vegetation).

3.4 Particulate Matter

The term “particulate matter” refers to a category of airborne particles (including solid particles, liquid droplets and aggregates of particles and liquids) that range from 0.1 micrometres (µm) to 50 µm in aerodynamic diameter and represents a complex mixture of organic and inorganic substances. Typical particle sizes are detailed in **Table 2**.

Table 2 Typical Particle Sizes for Particulate Matter

Pollutant	Example of Particle Sizes
Dust	> 30 - 50 microns
Total Suspended Particulates (TSP)	< 30 - 50 microns
PM_{10}	< 10 microns

Note: A micron (µm) is one-millionth of a metre ($1x10^{-6}$m).

Sources of particulate matter can be attributed to anthropogenic and natural sources (i.e. bush fires and dust storms).

3.4.1 Particulate Matter (as PM_{10} and $PM_{2.5}$)

Particles less than 10 µm and 2.5 µm are referred to as PM_{10} and $PM_{2.5}$. Emissions of PM_{10} and $PM_{2.5}$ are considered important pollutants in terms of impact due to their ability to penetrate into the human respiratory system as this can lead to a variety of health effects including heart or lung disease. Smaller particles can remain suspended in the air for days or weeks until removed by rain.

Sources of these particles include combustion sources (i.e. residential wood burning, motor vehicles, agricultural burning, and some industrial processes), coal mining, crushing and grinding, and materials handling and transfer.

3.4.2 Nuisance Dust and Total Suspended Particulate (TSP)

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM_{10}. Amenity concerns can relate to "visibility" of dust plumes and dust sources while amenity impacts include dust depositing on fabrics (i.e. washing), balconies, and the transport of dust from roofs to water tanks.

TSP refers to all particulates suspended in the air and is a good indicator of nuisance dust impacts. The measurement of deposited dust is also a measure of nuisance dust impacts. Sources of nuisance dust include combustion sources (i.e. residential wood burning, motor vehicles from the wear of tyres and brakes, agricultural burning etc) coal mining and wind-blown dust).

3.5 Carbon Monoxide (CO)

Carbon monoxide (CO) is an odourless, colourless gas. Increased CO concentrations in the blood reduces the amount of oxygen carried by haemoglobin around the body in red blood cells. CO bonds to the haemoglobin to form carboxyhaemoglobin which reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs. The result can lead to vital organs, such as the heart and the brain, do not receive enough oxygen to function properly.

CO is a product of the incomplete burning of fossil fuels. CO can be a common pollutant at the roadside with highest concentrations found at the kerbside and concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. Additional sources of CO include some industrial activities, such as steel fabrication. Natural sources of CO include volcanoes and bush fires.

3.6 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) is a colourless, pungent gas with an irritating smell. When present in sufficiently high concentrations, exposure to SO_2 can lead to impacts on the upper airways in humans (i.e. the noise and throat irritation). SO_2 can also mix with water vapour to form sulphuric acid (acid rain) which can damage vegetation, soil quality and corrode materials.

Main sources of SO_2 in the air are industries that process materials containing sulphur (i.e. wood pulping, paper manufacturing, metal refining and smelting, textile bleaching, wineries etc). SO_2 is emissions associated the combustion of coal in power stations and is present in motor vehicle emissions however since Australian fuels are relatively low in sulphur, high ambient concentrations are not common. Sewerage treatment facilities and pumping stations will also generate emissions of SO_2.

3.7 Lead

Lead is a highly toxic, heavy metal that is easily absorbed through ingestion, inhalation or other exposure routes. Particulate phase lead has the potential to be emitted into the air where it can remain suspended and present an inhalation risk to individuals. Symptoms of lead in the body include pain in joints and muscles, anaemia and nausea. Small children are most at risk because their bodies are still growing and developing, with symptoms of lead exposure including impaired intellectual development.

Main emissions of particulate lead to air are due to off-road vehicles, soil erosion and bushfire events. Many older houses were painted with lead-based paint, therefore house renovations can also release lead into the air if the proper controls are not in place. Lead was also used to be a petrol additive and was the source of high levels of lead in the air in major cities however since the introduction of unleaded petrol in 1985 ambient lead levels have dropped significantly. Industrial sources of lead emissions include smelters.

3.8 Air Toxics

Air toxics are a diverse range of air pollutants including volatile/semi-volatile compounds, benzene, polycyclic aromatic hydrocarbons, aldehydes and heavy metals. They are usually present in ambient air in relatively low concentrations but have characteristics such as toxicity and persistence that make them hazardous to human health. Reactive organic compounds in the air toxic group also play an important role in the formation of ozone. Sources of air toxics include motor vehicle and aircraft exhaust, burning of coal and wood for domestic heating purposes, industrial emissions, and fugitive emissions from materials such as paints and adhesives.

3.9 Summary of Air Quality Impact Assessment Criteria

The EPA has established ground level air quality impact assessment criteria for key air pollutants to achieve appropriate environmental outcomes and to minimise associated risks to human health as published in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005, hereafter, the Approved Methods). A summary of the impact assessment criteria for the pollutants identified above is given in **Table 3**.

These criteria and guideline reporting goals for key air quality pollutants such as ozone, NO_2, PM_{10}, $PM_{2.5}$, CO, SO_2, and lead have been sourced from the National Environmental Protection Council (NEPC); their published National Environment Protection Measure for Ambient Air Quality (Air NEPM) and Variation to Air NEPM, which outline agreed national objectives for protecting air quality for these criteria pollutants.

Table 3 Summary of Air Quality Impact Assessment Criteria

Pollutant	Averaging Period	Concentration (µg/m^3)	Source
Ozone (O_3)	1 hour	214	NEPC (1998)
	4 hours	171	NEPC (1998)
Nitrogen dioxide (NO_2)	1 hour	246	NEPC (1998)
	Annual	62	NEPC (1998)
PM_{10}	24 hours	50	NEPC (1998)
	Annual	30	EPA (1998)
$PM_{2.5}$	24 hours	25	NEPM (2003)
Total Suspended Particulate (TSP)	Annual	90	NHMRC (1996)
Carbon monoxide (CO)	15 minutes	100,000	WHO (2000)
	1 hour	30,000	WHO (2000)
	8 hours	10,000	NEPC (1998)
Sulphur dioxide (SO_2)	10 minutes	712	NHMRC (1996)
	1 hour	570	NEPC (1998)
	24 hours	228	NEPC (1998)
	Annual	60	NEPC (1998)
Lead	Annual	0.5	NEPC (1998)
Benzene (C_6H_6)[1]	1 hour	2.9×10^{-6}	VGG (2001); IARC Group 1 (2001)
Dioxins and furans (PCDD/DF) (I-TEQ)	1 hour	2.0×10^{-12}	VGG (2001); IARC Group 1 (2001)
Polycyclic aromatic hydrocarbons (PAHs)	1 hour	4.0×10^{-7}	VGG (2001); IARC Group 2A (2001)
Pollutant	**Averaging Period**	**Incremental Increase / Total (g/m^2/month)**	**Source**
Deposited Dust	Annual	2 / 4	NERDDC (1988)

Source: Approved Methods 2005

Note 1: The guideline for Benzene (C_6H_6) has been selected to assess the total volatile organic compounds (VOCs) as it is the most stringent guideline out of all the VOCs.

3.10 Odour

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines one odour unit (OU). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 OU to 10 OU depending on a combination factors including population sensitivity, background level, public expectation (considered offensive or easily tolerated), source characteristics (i.e. emitted from a stack or general area) and health effects.

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours, using a statistical approach which depends on the size of the affected population.

It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions, and community expectations of amenity.

A summary of the impact assessment criteria given for various population densities, as drawn from the Approved Methods, is given in **Table 4**. The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

Table 4 Impact Assessment Criteria - Complex Mixtures of Odorous Air Pollutants (nose-response-time average, 99th percentile)

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (OU)
Urban area (≥ 2000)	2
~500	3
~125	4
~30	5
~10	6
Single residence (≤ 2)	7

Source: Approved Methods 2005

3.10.1 Odour Impact Assessment Criterion Applicable to Wilton Junction

Given the development will represent a community population of approximately 34,955 persons (MacroPlan Dimasi), the 2 OU odour impact criterion will be adopted for this study.

4 RELEVANT AIR QUALITY GUIDELINES

4.1 Protection of the Environment Operations Act 1997 & Amendment Act 2011

The Protection of the Environment Operations (POEO) Act 1997 and Amendment Act 2011 are a key piece of environment protection legislation administered by the EPA which enables the Government to establish instruments for setting environmental standards, goals, protocols and guidelines.

4.1.1 General Air Quality Requirements

The following sections of the POEO Act are of general relevance to the Project.

- Section 117 of the POEO Act states that the wilful or negligent release of ozone depleting substances such as chlorofluorocarbons (CFCs) to the atmosphere carries the highest of all penalties under NSW environmental law.
- Section 124 and 125 of the POEO Act state that any plant located at a premise (e.g. spray booth filtration and exhaust system) should be maintained in an efficient condition and operated in a proper and efficient manner to reduce the potential for air pollution.
- Section 126 of the POEO Act requires that materials are managed in a proper and efficient manner to prevent air pollution.
- Section 128 of the POEO Act states:
    1. The occupier of a premises must not carry on any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.
    2. Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.
- Section 129 of the POEO Act states that odours generated by operational activities should not be detectable beyond the site boundary.
- Section 133 of the POEO Act states that the EPA may prohibit the burning of fires in the open or burning of waste in an incinerator. These activities are illegal in most local Council areas.

Changes under the POEO Amendment Act 2011 include that the owner of a premises, the employer or any person carrying on the activity which causes a pollution incident is to *immediately* notify the relevant authorities when material harm to the environment is caused or threatened.

4.2 Protection of the Environment Operations (Clean Air) Regulation 2010

The POEO (Clean Air) Regulation 2010 (the Regulation) is the core regulatory instrument for air quality issues in NSW.

In relation to industry, the Regulation:

- sets maximum limits on emissions from activities and plant for a number of substances.
- deals with the transport and storage of volatile organic liquids.
- restricts the use of high sulphur liquid fuel.
- imposes operational requirements for certain afterburners, flares, vapour recovery units and other treatment plant.

Part 5 (Division 3) of the Regulation deals with the emissions of air impurities from activities and plant, and sets maximum limits on emissions for a number of substances (including solid particles and visible smoke). The standards of concentrations prescribed by Part 5, Division 3 do not apply to or in relation to any plant during start-up and shutdown periods, however are still subject to requirements of Section 128 (2) of the POEO Act in relation to the prevention and minimisation of air pollution.

The Regulation notes that the EPA may grant an exemption in relation to smoke emitted in the course of activities such as research to improve safety in relation to the flammability of materials and smoke reduction or testing undertaken to certify that manufactured or imported products comply with Australian Standards, International Standards or meet any legislative requirements place on them.

Part 6 of the Regulation outlines the control of VOCs and the requirement for any fuel burning equipment or industrial plant to be fitted with control equipment. Exemptions exist where approved by the EPA.

4.3 NSW Environment Protection Authority Air Quality Policy and Guidance

The EPA is the NSW regulatory authority responsible for air quality regulation and associated activities. Approved Methods

The EPA publication, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the Approved Methods), lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2002 for assessment of impacts of air pollutants.

4.3.1 Odour Technical Framework and Notes

The EPA publications, *Technical Framework: Assessment and management of odour from stationary sources in NSW* and the associated *Technical Notes* (the Odour Policy), provide a policy framework for assessing and managing activities that emit odour and offers guidance on dealing with odour issues.

4.3.2 Local Air Quality Toolkit

The Local Government Air Quality Toolkit (AQ Toolkit) has been developed by the EPA to assist local government in their management of air quality issues and provides guidelines for air quality management and for the use of air pollution control techniques.

4.4 Building Code of Australia and Australian Standards

The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government with the aim of achieving nationally consistent, minimum necessary standards of relevant health and safety, amenity and sustainability objectives efficiently.

The BCA contains mandatory technical provisions for the design and construction of BCA class buildings. Volume 1, Section F4 and J5.5 of the BCA (2011) specifically addresses amenity and energy efficiency in relation to building ventilation and exhaust systems.

Australian Standard (AS) 1668.2-2002 *"The use of ventilation and air conditioning in building, Part 2: Ventilation design for indoor air contaminant control*" sets design requirements for mechanical ventilation systems. Mechanical ventilation is required in enclosures where specific health and ventilation amenity requirements cannot be met by natural means.

Section 5 of the AS states the following:

- 5.2.2 Exhaust locations: As far as practicable, exhaust-air intakes used for general exhaust-air collection shall be located on the opposite sides of the enclosure from the sources of make-up air, to ensure that the effluents are effectively removed from all parts of the enclosure.
- 5.3.2.1 General requirements: The effluent shall be collected as it is being produced, as close as practicable to the source of generation.
- 5.10.1 Air discharges: Where discharges are deemed to be objectionable (i.e. nuisance related), discharges shall:
    - Be emitted vertically with discharge velocities not less than 5 m/s.
    - Be situated at least 3 m above the roof at point of discharge.
    - Treated to reduce the concentration of contaminants where required.
    - Be emitted to the outside at velocities and in a direction that will ensure, to the extent practicable, a danger to health or a nuisance will not occur.

- Be situated a minimum separation distance of 6 m (where the airflow rate is ≥ 1,000 L/s) from any outdoor) air intake opening, natural ventilation device or opening, and boundary to an adjacent allotment, except that where the dimensions of the allotment make this impossible, then the greatest possible distance shall apply.

4.5 Development Near Rail Corridors and Busy Roads

The DP&E (formerly the Department of Planning) released an interim guideline in 2008 entitled "*Development near rail corridors and busy roads"* (hereafter, the 2008 Development Guidelines). The aim of the guideline is to assist in reducing the health impacts of rail and road noise and adverse air quality on sensitive adjacent development through planning and design considerations.

Under the guideline, a busy road is defined:

- a freeway or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles
- any road with an AADT volume of more than 20,000 vehicles
- any road with a high level of truck movements of bus traffic

4.6 Preliminary Assessment of Buffer Distances

In situations where the specifics of a development are unknown (i.e. the potential locations of residential developments, or the nature, scale and potential impact of industrial or commercial land uses), the application of buffer distances provide a valuable 'screening' tool to judge whether a detailed assessment is required to evaluate the potential risk of conflicting land uses.

The EPA has not published buffer distances that may be used to reduce the possibility of conflicting land uses in NSW. In lieu of relevant NSW guidance, reference has been made to Victoria Environment Protection Authority (VIC EPA) documentation as relevant referenced buffer (or separation) distances.

4.6.1 VIC EPA Recommended Separation Distances for Industrial Residual Air Emissions

In accordance with Clause 13.04-2 (Air Quality) of Victoria's State Planning Policy Framework, all planning must consider the VIC EPA's "*Recommended Separation Distances for Industrial Residual Air Emissions*" (2013). In their document, the VIC EPA makes recommendations for assessing appropriate separation distances where amenity may be reduced for sensitive or incompatible land uses. Sensitive land uses which warrant protection from amenity-reducing off-site effects of industry by maintenance of a suitable separation distance include residential areas and zones, hospitals and schools.

A summary of the industrial residual air emissions (IRAE) separation distances which may be applicable to the proposed urban development are provided below. It is noted that these values have been provided for guidance only and are not regulatory guideline values. IRAEs are defined by the EPA as unintended or accidental emissions (i.e. due to equipment failure, abnormal weather conditions etc) which are often episodic in occurrence and may originate near ground levels.

Table 5 VIC EPA Recommended Separation Distances for Industrial Residual Air Emissions

Industry Type	Recommended Distance (m)
Agriculture	
Grain and stockfeed mill and handling facility (>20,000 T per year)	250
Basic Metal Products	
Iron and Steel Production (<1,000,000 T per year)	500
Non-ferrous metal production (<100 T per year)	100
Food, beverages and manufacturing	
Abattoir – no rendering (>200 T per year)	500
Bakery (>200 T per year)	100
Flour Mill (>200 T per year)	250
Poultry processing works (no rendering)	500
Rendering and casings works	1,000
Mining and Extractive Industry	
Gas and oil extraction	250
Mine for other minerals	250
Quarry – without blasting (blasting)	250
Quarry – with respirable crystalline silica	500
Miscellaneous Manufacturing	
Printing (emitting >100 kg per day)	500
Non-metallic Mineral Products	
Brick, tile, pipe and refractory manufacturing (>10,000 T per year)	250
Cement manufacturing (>150,000 T per year)	1,000
Concrete and stone article manufacturing (< 5,000 t per year)	100
Concrete plant (>5,000 T per year)	100
Storage and Transport	
Storage of petroleum and hydrocarbon products (tanks > 2,000 T) - floating roof / fixed roof	 100 / 250
Waste management	
Transfer station	250

5 REGIONAL AND LOCAL AIR QUALITY INFLUENCES

5.1 Regional Air Quality Influences

Ozone (O_3) is a key atmospheric pollutant of concern during the summer months in Greater Sydney. Further, exceedances of ozone standards tend to occur more frequently in south western Sydney although emissions of ozone precursors such as oxides of nitrogen (NO_X) and volatile organic compounds (VOCs) from elsewhere within the Sydney airshed contribute to these elevated levels.

Air movement plays an important role in the formation and transportation of ozone in the Sydney basin. There are several mechanisms which give rise to elevated levels of ozone. One of the key mechanisms contributing to peak ozone levels in western Sydney is the Sydney sea breeze.

In summer, light drainage flows (movements of cool air down slopes) move across the Sydney region towards the coast and out over the sea. Emissions of VOCs and NO_X, produced by morning peak hour traffic and other sources, can be transported offshore in these flows. The photochemical smog precursors typically remain offshore until the arrival of the sea breeze and, in the presence of sunlight begin to react. Ozone is produced relatively slowly over several hours as a product of the photochemical reaction of the VOCs and NO_X. The sea breeze usually develops in the late morning to early afternoon and, in Sydney, is typically from the north-east. This sea breeze transports the reacting precursors across the Sydney basin arriving in western Sydney mid to late afternoon by which time the ozone concentration in the air has increased to the level where all the precursors have reacted. This "aged" photochemical smog concentration can increase as fresh emissions of NO_X and VOCs are mixed into the air as it travels across the basin.

Ozone in western Sydney can occasionally be high during the morning period given a number of factors:

- Precursors being recirculate overnight by local and regional drainage flows in western Sydney and then carried southwards along the Hawkesbury Basin by light northerly gradient winds.
- Sydney emissions trapped in western Sydney by a north-south rotor circulation (southerly drainage flow and northerly synoptic winds).
- Overnight trapping of Sydney emissions within a deep circulation in western Sydney resulting from the blocking of north north-easterly stable synoptic winds by the topography of the Sydney Basin.

Elevated levels of ozone are associated with increases in mortality, hospital admissions, respiratory symptoms, and decreases in lung function. Studies in Sydney have demonstrated associations between ozone and mortality, and ozone and lung function, especially among susceptible sub-groups, such as asthmatics.

Given the above consideration, any developments planned for south western Sydney should take note of the potential for ozone exceedances and take action to reduce the levels of precursor pollutants which they emit. Any increase in traffic associated with a development may increase the levels of NO_X and VOCs within the airshed, which may compound existing adverse air quality, especially in summer months.

5.1.1 Recent Studies on Regional Air Quality for NSW

The Metropolitan Air Quality Study, 1996 (MAQS)

The EPA's document "*Metropolitan Air Quality Study – Outcomes and Implications for Managing Air Quality"* (EPA 1997) highlights the complexity of the Sydney, Hunter and Illawarra airshed with meteorological factors giving rise to quite different patterns of pollution from day to day and from region to region within the airshed (Hyde et al., 1997) and recognises that the development in Sydney's south-west has the potential to increase air pollutant emissions.

Current and Projected Air Quality in NSW - A technical paper supporting the Clean Air Forum 2007

The EPA's document, "*Current and Projected Air Quality in NSW - A technical paper supporting the Clean Air Forum"* (DECC 2007) provides a summary of ambient air quality trends from 1994 to 2006 and details recent airshed computer modelling of possible emission reduction scenarios for meeting the standards for ozone in Sydney.

The report states that air quality has improved substantially since the 1980s, particularly given improved engine emissions controls, stricter vehicle emissions standards and the introduction of unleaded petrol, however as the population centres grow, these gains are being countered by an increasing number of vehicles and vehicle-kilometres travelled resulting in traffic congestion and air pollution.

Review of Background Air Quality Monitoring Data

Background air quality monitoring data measured between 1996 and 2006 across the OEH's statewide network of air quality monitoring stations, showed that ozone, and to a lesser extent fine particles (as PM_{10}), remain significant issues in NSW, and this is particularly apparent in the case of ozone in western Sydney and fine particles in rural cities in NSW. The report notes that strategies for managing ozone (as smog) are dependent on reducing emissions of VOCs and NO_X. Levels of other key pollutants (i.e. CO, NO_X, SO_2, lead and most air toxics) were well below relevant air quality standards.

The National Dioxins Program in 2002 to 2003 highlighted a seasonal cycle in dioxin and furan concentrations, with higher levels in winter most likely due to smoke from solid-fuel heaters. It is noted that some air toxics (i.e. benzene) require ongoing assessment to ensure they remain at acceptable levels however strategies such as increasingly stringent regulation of fuel and motor vehicle emissions and improvements in solid-fuel heaters will assist in controlling air toxics.

Monitoring data from 1994 to 2006 shows that ozone standards were exceeded in Sydney every year during this period of time. The majority of ozone exceedances were noted to occur as single-day events. The report notes that exceedances of both the 1-hour and 4-hour standards occur more frequently in western Sydney however analysis has demonstrated that practically all parts of the Sydney region can experience ozone levels above standards at some time. Analysis of the daily maximum 1-hour and 4-hour ozone concentrations in Sydney between 1994 and 2006 showed that there has been a slight upward trend in ozone from the mid-1990s and no improvement in ground-level ozone since 1998.

In NSW, the highest exposure to fine particles occurred during severe bushfires and dust storms. The effects of prolonged drought conditions in NSW rural cities, such as more bushfires and dust storms, where also shown to increase levels of fine particles. A strong seasonality to PM_{10} levels in NSW was also noted with the majority of exceedances occurring during spring and summer in Sydney, and during summer and autumn in rural cities. During summer, PM_{10} exceedances were multi station events, indicating that sources of PM_{10} are more likely to be widespread or regional-scale, which may indicate the influence of bush fires or dust storms, or exceedances could be indicative of secondary particles produced during the formation of photochemical smog (however the report notes that this is uncertain and further compositional analysis of particle samples is needed).

Future Air Quality Projections

The airshed modelling system used was developed as part of MAQS and uses data provided in the MAQS emissions inventory, which summarises emissions from all known sources in the Sydney, Newcastle and Wollongong regions. The model combines the emissions data with detailed photochemical mechanisms and meteorological data to simulate the reactions leading to ozone formation. It then predicts where ozone is formed and transported over time.

The modelling results show that for the Sydney region in 2002, an overall reduction in both NO_X and VOCs of the order of 25% is required to consistently meet the current standards. According to the modelling study, ozone formation in the Sydney basin is most sensitive to reductions in vehicle emission controls and to VOC emission reduction in the short to medium term (i.e. 2016) but for a longer term reduction in ozone (i.e. 2026), and based on a business as usual scenario, a reduction in both VOC and NO_X emissions are required.

In summary, the scenario modelling showed that for business as usual scenario in 2026:

- Total reduction of both VOCs and NO_X resulted in improved compliance with the 1-hour standard by 2026, but there were still exceedances of the 4-hour ozone standard.
- While significant gains are likely from currently mandated control of motor vehicle emissions, these alone are insufficient to meet current ozone goals.
- Despite this expected reduction in vehicle emissions, motor vehicles will remain a significant source of the precursor pollutants.

Action for Air Policy

The NSW Government's 25-year Air Quality Management Plan, *Action for Air*, is the latest in a series of measures that have resulted in increased controls on industry, cleaner motor vehicles and fuels, and controls on emissions from commercial premises and domestic sources.

The *Action for Air - 2009 Update"* (DECCW 2009) provides an overview of air quality for the Sydney, Wollongong and the Lower Hunter region over the past 10 years and states that major challenges are still to be faced in relation to ozone and particle pollution, and the fact that these are likely to be exacerbated by climate change.

Recognising that ozone and particle pollution are a key problem in NSW, the plan continues to focus on improving emissions of the vehicle fleet. Projected growth in vehicle travel is also significant, particularly in road freight. The Action for Air plan suggests measures to protect and improve air quality in Sydney including the provision of improved transport options and the implementation of regional transport plans. These measures would help to enable sustainable development of the south-west including Wilton.

The Cleaner Vehicles and Fuels Strategy (the Strategy) released in 2008 is a key strategy in this plan and builds on the Government's existing actions to reduce pollution from vehicles. The Strategy also works in conjunction with planning and transport actions to reduce vehicle dependence and traffic congestion.

Further actions associated the plan include, but are not limited to, the following measures:

- Stage 2 vapour recovery (VR2) for capture of VOC emissions from vehicle petrol tanks during refuelling activities. VR2 technology can reduce refuelling emissions by over 85%. Stage 1 vapour recovery (VR1) which captures VOC emissions from underground storage tanks as they are filled by road tankers will be extended to all parts of Sydney.
- Improved transport choices such as bus and rail initiatives, a metropolitan-wide parking policy.
- Progress nitrogen oxide policy for new industry.
- Green Business Program to help businesses save energy and water in their operations.
- Sustainability Advantage Program to help business manage environmental risk and integrate environmental strategies with business planning.
- Low emissions air program for smash repairers.
- Reduce particle emissions from wood heaters.
- Improved residential building standards through BASIX, the Building Sustainability Index.
- Provision of a guideline for development near rail corridors and busy roads.
- The NSW BikePlan to determine targets for bicycle usage and other metrics that describe the health of the bicycle environment.
- Enhance the public health alert system.
- Community awareness and behaviour change education programs.

EPA Emissions Inventory

The EPA have developed a detailed emissions inventory which covers emissions from all source sectors, including vehicles, industrial, commercial and domestic sectors and natural sources, and collates emissions data by type, source and location over time. The inventory is drawn from industry, government, surveys and estimates.

By showing in detail where the air pollution is coming from, the emissions inventory can be used to help identify and target key areas for pollution reduction programs and develop better approaches to improving air quality. (Refer to **Section 8.5** for estimated emissions for the Wollondilly LGA.)

5.2 Local Air Quality Influences

Emissions to air may be categorised as either controlled emission sources or uncontrolled ("fugitive") emissions. Controlled emission sources are typically directed into a vent or stack and emitted into the atmosphere. Fugitive emissions are uncontrolled releases and may be due to accidental spillage, leakage, materials handling, transfer or storage.

Emission sources associated with Wilton Junction Precinct (hereafter, the Project) will likely comprise a combination of controlled source and fugitive sources, but primarily fugitive emission sources.

5.2.1 Overview of Sectoral Pollutant Contributions

The following sources have the potential to influence the background air quality within the Wollondilly LGA:

- Mobile sources, including on-road motor vehicles (particularly those using the Hume Highway), off-road motor vehicles, and light aircraft.
- Major industrial/commercial sources such as coal seam methane gas power stations, underground coal mining operations, cement manufacturers and poultry farms.
- Light industrial/commercial sources such as refuelling stations, drycleaners, and automobile repairers.
- Local infrastructure sources including sewage treatment plants and sewage pumping stations.
- Domestic sources such as lawn mowing and wood heaters.

5.2.2 Existing Industrial Sources of Air Pollutants Surrounding the Project Site

The following sources have been identified from desktop mapping study of sites regulated under by EPA and required to report to the National Pollutant Inventory (NPI).

Environment Protection Licences (EPL) are issued under the Protection of the Environment Operations Act 1997 (POEO Act) and are regulated by the EPA. EPLs stipulate emission limits to water, land and/or air and provide operational protocols to ensure emissions/operations comply with relevant standards. General requirements of EPLs relating to air quality include:

- Plant and equipment to be maintained and operated in a proper and efficient manner.
- Emissions of dust and odour are to be minimised/prevented from the premises.

The NPI database provides details on industrial emissions of over 4,000 facilities across Australia. The requirement to return emissions estimates to the NPI is determined by the activities/processes being undertaken at the facility, and also whether those processes exceed process-specific thresholds in terms of activity rates (i.e. throughput and/or consumption). It is not intended to make a statement that impacts associated with those activities will be significant in terms of their potential for impact, generation of complaint, or constraint to the development of the Project site.

A search of the EPA public register and NPI database for the Wollondilly LGA returned the following information for existing industries in the vicinity of the subject land, applying an arbitrary cut off distance of 10 km. It is noted that NPI data is provided for the NPI 2011/12 reporting year.

Table 6 Surrounding Industrial Sources

Facility Name	Sector	Address	Approximate Distance (km)/ Direction from Project Site	EPL/NPI Requirements
Allied Mills Australia	General agricultural processing	330 Picton Road, Maldon, NSW 2571	1.6 / N	General EPL air quality requirements apply. Completed a Pollution Reduction Plan (PRP) Air Quality Verification of 32 emissions points for particulate matter emissions in 2009.
(Illawarra Coal Douglas Project Wilton) Appin West Coal Mine, Endeavour Coal	Mining for coal Waste disposal by application to land Coal works	Douglas Park Drive, Wilton NSW 2569	1.7 / E	Main NPI emissions are CO and NO_X. Review of Air Quality Impact Assessment shows compliance with air quality standards at nearest sensitive receptors.

Facility Name	Sector	Address	Approximate Distance (km)/ Direction from Project Site	EPL/NPI Requirements
Maldon Cement Works, Boral Cement Limited	Cement or lime production	40 Maldon Bridge Road, Maldon, NSW 2571	1.9 / NW	Cement Mill Baghouse/Precipitator, Clinker Kiln and Dryer Stack emissions monitoring. Main NPI emissions are NO_X, carbon monoxide (CO), particulate matter (as PM_{10}) and sulphur dioxide (SO_2).
Tower CSM Power Station, EDL CSM (NSW)	Generation of electrical power from gas	Douglas Park Drive, Douglas Park, NSW 2569	2.0 / E	Burn engines, ambient air and weather monitoring station (Brookes Point rd), NO_X analyser for stacks, coal seam methane vent monitoring and reactive management plan. Main NPI emissions are NO_X, CO, total VOCs and formaldehyde. Review of Air Quality Impact Assessment shows compliance with air quality standards at nearest sensitive receptors.
Picton Sewage Treatment System, Sydney Water Corporation	Sewage treatment processing by small plants	Remembrance Drive, Picton, NSW 2571	2.5 / WNW	General EPL air quality requirements apply. Secondary treated effluent used to irrigate fodder grown on the Picton Reuse Farm Scheme and tertiary treated effluent used around the plant and discharged to creek.
Wollondilly Abattoirs	Slaughtering or processing of animals	48 Koorana Road, Picton, NSW 2571	3.4 / W	General EPL air quality requirements.
Tahmoor Power Generation Plant, Envirogen Pty Ltd	Generation of electricity power from gas	Remembrance Driveway, Tahmoor, NSW 2573	4.3 / W	Exhaust stacks monitoring.
Tahmoor Coal Mine, Xstrata Coal (managed by Tahmoor Coal)	Sewage Treatment processing by small plants Mining for coal Coal works	Remembrance Drive, Tahmoor, NSW 2573	5.6 / SW	Underground coal mining operation. PRP coal mine particulate control best practice completed 2012. Main NPI emissions are CO.
Tahmoor Plant, Inghams Enterprises	Slaughtering or processing animals	Rockford Road, Tahmoor, NSW 2573	6.7 / SSW	Main NPI emissions are ammonia.
Appin Coal Seam Methane (CSM) Power Station, EDL CSM (NSW)	Generation of electrical power from gas	Northhampton Dale Road, Appin, NSW 2560	7.2 / E	Stacks servicing burn engines are monitored. Also ambient air/ weather monitoring, NO_X analyser for stacks, coal seam methane vent monitoring, reactive management plan. Main NPI emissions are total VOCs, NO_X and CO.
Bargo Waste Management Centre, Wollondilly Shire Council	Waste disposal by application to land	Anthony Road, Bargo, NSW 2574	7.2 / SW	Surface gas emission and gas accumulation monitoring.
Inghams Appin Broiler Complex, Inghams Enterprsies	Bird accommodation	345 Appin Rd, Appin, NSW 2560	8.2 / NE	Complex comprising approximately 100 poultry farm sheds. General EPL air quality requirements. Main NPI emissions are ammonia and PM_{10}.

Facility Name	Sector	Address	Approximate Distance (km)/ Direction from Project Site	EPL/NPI Requirements
Baines Masonary Blocks	Concrete works	900 Wilton Road, Appin, NSW 2560	8.0 / E	General EPL air quality requirements.
Inghams Rearing Farm A, Inghams Enterprsies	Poultry Farming	3010 Remembrance Drive, Bargo, NSW 2574	8.9 / SW	Main NPI emissions are ammonia.
Inghams Bargo Breeder Farm B, Inghams Enterprsies	Poultry Farming	3010 Remembrance Drive, Bargo, NSW 2574	9.7 / SW	Main NPI emissions are ammonia.
Rosalind Park Gas Plant, AGL	Petroleum products and fuel production	Medhurst Road, Gilead, NSW, 2560	10.2 / NE	Main NPI emissions are CO and NO_X.
Appin Coal Mine, Endeavour Coal	Mining for coal Waste disposal by application to land Coal Works	Off Appin Road, Appin, NSW 2560	10.3 / E	Main NPI emissions are NO_X and PM_{10}. Review of Air Quality Impact Assessment shows compliance with air quality standards at nearest sensitive receptors.

Additional industries existing in the local area may operate below the activity threshold specified for the industry, and hence do not need to report under the NPI program. Sources that potentially fall under this category may still constitute a constraint to the development of surrounding incompatible land uses, but on a smaller scale than those required to report under the NPI program.

Additional Sources in the Vicinity of the Project Site

In addition to the above NPI and EPA regulated industries, the Project site is also located nearby by the following industries:

- Wilton Quarry, Lot 7, 155 Wilton Road, Wilton, located approximately 1.8 km east of the Project site. This source has the potential to generate nuisance dust, PM_{10}, and respirable silica (associated with sandstone) assuming the quarry is still operational. It is noted that the declaration for this project has been revoked, so it is no longer subject to Part 3A of the EP&A Act.
- Poultry farms which have the potential to generate nuisance odour, including:
  - 5 sheds at Nixon J Poultry Farm on Ashwood Road, Wilton, approximately 895 m east of the Project site.
  - 2 farms each with 3 sheds located off Pheasants Nest Road, Pheasants Nest, approximately 2.8 km and 3.3 km south from the Project site.
  - A total of 7 sheds located off Cross St, Maldon, approximately 3.4 km and 3.8 km west of the Project site.
  - 4 sheds located off Koorana Road, Maldon, approximately 3.6 km west of the Project site.
  - 5 sheds, located on Wilton Road, Wilton, approximately 7.5 km east of the Project site.
  - 10 sheds, located on Yarran Road, Bargo, approximately 8 km south-west of the Project site.
- Macarthur Motorcycles located off Appin Road, Appin, approximately 8.4 km north-east of the Project site. This source has the potential to generate air quality impacts due to the combustion of fossil fuels.

  Given its distance from the Project site this activity is not considered further in this assessment. Bikes using the track should meet with usual requirements of the POEO Act and Roads and Maritime Services (RMS) vehicle standards.

- BHP Billiton Illawarra Coal, Appin Colliery Area 7 Goaf Gas Drainage Project and Ventilation Shaft 6 located approximately 2.8 km to the north-east of the Project site. The gas drainage project comprises the installation and operation of 8 boreholes over Appin Area 7 longwalls in order to extract gas from the goaf. The gas will be collected in a reticulation system and directed underground to be incorporated in to the pipe range supplying gas to the Appin West or Appin Power Station. This source has the potential to generate nuisance odour, NO_X, CO, PM_{10} and nuisance dust due to gas flaring stacks, gas vent stacks, diesel generator use and construction/drilling works. Primary pollutants of concern due to the operation of the Ventilation Shaft No.6 will be particulate matter and odour.

  The PAE Holmes-prepared documents "*Air Quality Impact Assessment: Appin Mine Area 7 Goaf Gas Drainage Project*" (2009) and "*Air Quality Impact Assessment – Ventilation Shaft No.6 Project*" (2010) demonstrate that predicted levels of these pollutants meet with relevant EPA air quality criteria at nearby residences in Douglas Park. This activity is therefore not considered further in this assessment.

5.2.3 Potential Future Sources within or in the Vicinity of the Project Site

A review of major projects registered with the DP&E was conducted using the DP&E's web search tool. The results of this review are provided below:

- A prefeasibility report has been prepared for the continuation of the Maldon-Dombarton Rail Line (MDRL) project, which was abandoned in the late 1980s due to downturn in the global economy and the closure of a number of regional coal mines. The MDRL would operate from the Main South rail line at Maldon (near Picton) to an existing 15 km section of dual track from Dombarton to Port Kembla, and would comprise 24 hour freight including transport of coal from existing and proposed coal mines in Appin-Wilton area to Port Kembla for export overseas. Part of the MDRL would operate through the Project area.
- Picton Sewerage Scheme Boundary Expansion to allow additional connections to seven growth areas on the outskirts of Picton, Tahmoor, and Thirlmere via a gravity reticulation network and transfers through SPS to the Picton Water Recycling Plan and the Picton Reuse Farm Scheme. This expansion project would be located to the west of the Project site at numerous locations.

  Conditions of approval were issued in January 2013. Odour modelling and monitoring is to be carried out when the first full twelve months of meteorological data is obtained, with further odour controls to be implemented where the modelling shows unacceptable odour impacts. It is noted that odour complaints can be high in the early years of operation of a new wastewater system when flows are low and wastewater travel times are higher.
- Tahmoor South Coal Project and Redbank Tunnel Rail Deviation located approximately 5.4 km to the south-west of the Project site. DGRs were issued in November 2012.
- Bargo Resource Recovery Facility and Transfer Station to be located at 25 Government Road, Bargo, approximately 7.7 km to the south-west of the Project site. DGRs were issued in April 2013.AGL received planning approval for the development of an open-cycle gas fired peaking power station at Leafs Gully on Appin Road, Campbelltown, in August 2009. A community consultation process is currently ongoing and stringent environmental conditions have been imposed on the project.

Refer to **Section 9.2** for an assessment of the potential impacts of existing and potential future sources of air pollutants at and surrounding the Project site.

5.2.4 Existing Sources of Air Pollutants at the Project Site

The following potential sources have been identified from desktop mapping study of the Project site:

- The Sydney-Moomba gas pipeline dissects the Project site from the southern end, across Picton Road and up into Bingara George, then eastwards to the existing Wilton town. Natural gas is odourless however the gas is odorised with merceptans for health and safety reasons (i.e. leak detection), hence significant odour emissions may be associated with rupture of the pipeline and/or emergency venting episodes as mercaptans give the natural gas a distinctive rotten egg smell.
- Skydiving Centre, Wilton Airport, Picton Road, Wilton. This source has the potential to generate air quality impacts due to combustion of fuels from air traffic. However, the skydiving centre has not been included as part of the Wilton Junction Master Plan and is therefore not considered further in this assessment.

- Parelli Natural Horsemanship, 50 Lisa Road, Wilton. This source has the potential to generate nuisance odour impacts where horses are kept on site however impacts are anticipated to be largely controllable at source through appropriate manure management measures and location of manure stockpiles away from sensitive receptor locations and is not considered further in this assessment.

Refer to **Section 9.3** for an impact assessment of existing sources of air pollutants.

5.2.5 Potential Future Sources of Air Pollutants - Construction Phase of the Development

Main emissions to air during construction works will include:

- **Transportation/Plant and Machinery:** The emission of products of combustion including NO_X CO, CO_2, SO_2, VOCs and particulate) from worker transport (i.e. light vehicles) and construction equipment (such as trucks, excavators, bulldozers, generators, etc).
- **Site Preparatory/Construction Works:** Nuisance dust and particulate from site preparation works and earthworks such as those associated with the unloading and loading of materials, clear and grade activities, general construction activities, the handling and transport of materials, wind erosion of open areas and material stockpiles.
- **Fuel Storage and Transfer:** Fugitive release of VOCs emissions from the storage and transfer of diesel and other fuels.
- **Workshops/Worker's Yards:** Emissions of dust and fumes from the workshops (e.g. from sanding, welding and the use of solvents for cleaning equipment parts).

Refer to **Section 9.4** for the assessed construction phase impacts. Mitigation measures have been provided in **Section 11.2**.

5.2.6 Potential Future Sources of Air Pollutants – Operational Phase of the Development

Operational Phase

- **Traffic/Transportation:** Products of combustion from motor vehicle exhaust (i.e. passenger buses, light vehicles, heavy vehicles), particularly along the Hume Highway and Picton Road.
- **Sewage Treatment Plant (STP), Wastewater Treatment Plant (WWTP) and Sewage Pumping Stations (SPS):** Emissions of odour (i.e. ammonia, amines, and sulphides such as organic sulphides and hydrogen sulphide) from the existing (or upgraded) Bingara Gorge STP, the separately proposed WWTP for the Project, and all associated pumping stations, particularly during abnormal operations, upgrade and maintenance works, and due to the storage, handling and disposal of waste.
- **Light Industry/Commercial:** Highway services, drycleaners, general warehousing have the potential to generate emissions of VOCs, NO_X, PM_{10}, and nuisance dust. Food outlets have the potential to generated nuisance odour and particulate.
- **Surface Coating:** The application of new surface coatings to buildings and interiors will generate emissions of VOCs from paint and solvent use.
- **Lawn Mowers (Domestic/Commercial):** Products of combustion and emissions of VOCs due to fuel spillages (i.e. evaporative) and the combustion of fuel.

Wood Heaters: Emissions of particulate and air toxics from wood heaters in winter months, particularly when, in some airsheds, emissions are trapped under a cold air layer (which sits over a warmer air layer i.e. an inversion layer) that prevents dispersion and may pose a significant health risk due to increased exposure. Refer to **Section 9.5** for an assessment of potential impacts from sources of air pollutants associated with the operation of the Project. Best practice mitigation measures have been provided in **Section 11.3**.

5.2.7 Key Pollutants

Based on the above identified potential sources of air pollutants, and taking into consideration regional air quality issues discussed in **Section 5.1**, key pollutants for the assessment are identified as:

- Fugitive and point source releases of VOCs and NO_X which have the potential to increase the levels of ozone in the atmosphere.

- Products of fossil fuel combustion (in particular VOC, NO_X, CO and SO_2) which have the potential to impact on the life, health and well-being of humans.
- Fugitive releases of particulate emissions (as PM_{10}, $PM_{2.5}$, and nuisance dust) which have the potential to impact on the health and well-being of humans, and ambient air quality amenity.

Key pollutants are described in more detail in **Section 3**.

5.3 Summary

A review of the existing and future proposed industries (and other potential sources of air pollutants) both within and surrounding the Project site has been undertaken to identify those sources which could possibly cause a constraint in terms of air quality on future sensitive land uses planned within the Project area.

The potential impact of these sources has been assessed in **Section 9** applying a risk-based (qualitative) assessment. This risk-based assessment takes into account a number of factors including the type of pollutants emitted by an industry (particularly key pollutants identified in the preceeding section) and separation distances existing between industrial uses and future planned sensitive land uses (refer to **Table 5** for a list of recommended separation distances).

6 PREVIOUS AIR QUALITY STUDIES

6.1 Proposed Wilton Residential Development – Air Quality Study (2002)

The 2002 report prepared by Sinclair Knight Merz (SKM) Pty Ltd applies three separate metrics as a means of ranking the significance of 1-hour ozone detected at the OEH's regional network of monitoring stations, drawing comparisons between the air quality in south-west, north-west and eastern Sydney. The results of the assessment show that that the impact of ozone is greater in north-west and south-west Sydney (including Wilton) than compared to eastern Sydney.

6.2 Proposed Residential Subdivision at Condell Park, Wilton – Air Quality Assessment (2000)

SKM was commissioned by Bradman Corporation to provide an overview of existing air quality in Sydney's south west in relation to a medium density residential development proposed for the Wilton area. The review concluded that the air quality in the vicinity of Wilton, depending on the criteria and analysis methods used, is not significantly different from other areas of the Greater Sydney metropolitan area.

The review further notes that the summer north-east sea breeze has a lower frequency of reaching Wilton than Campbelltown/Camden and that the sea breeze 'loses energy' with distance south-west, particularly given the reasonably steep terrain existing between Campbelltown and Wilton. It is also expected that at night, cold air drainage down the southern highlands would generally flush the Wilton area with clean air from further south-west, providing improved air quality.

Recommendations made by the review include improving transport infrastructure in the south-west to remove the reliance on private motor vehicles use associated with new developments in the south west.

6.3 Supplementary Traffic Review of Proposed Wilton Junction Development (2013)

A review of the traffic study entitled "*Supplementary Traffic Review of Proposed Wilton Junction Development*", February 2013, as prepared by Colston Budd Hunt & Kafes Pty Ltd, was undertaken as further sensitivity testing of the traffic effects of the proposed development.

The supplementary traffic review assessed scenarios representative of likely conservative case and worst case traffic effects for 2012, an intermediate level of development scenario featuring minimal employment on site and hence no additional trip containment, and for 2031 as a longer term time frame.

The road network in the vicinity of the Project site comprises the Hume Highway (South Western Freeway), Picton Road, and Pembroke Parade, Menangle Road and Almond Street.

- The Hume Highway bisects the Project site in a north south direction and provides a four lane divided carriageway with a full interchange at Picton Road. Turning movements at the interchange are uncontrolled.
- Picton Road bisects the Project site in an east west direction, is generally a two lane undivided road with sealed shoulders however is a four lane undivided road with a posted speed limit of 80 km/h between the Hume Highway and Pembroke Parade.
- Pembroke Parade provides access to Bingara George and provides one traffic lane in each direction. The intersection of Pembroke Parade and Picton Road is a priority controlled T-intersection.

The review concludes that significant traffic increases along Picton Road by 2021 would result in existing priority controlled intersections reaching capacity before 2021 and road upgrades would be required to provide alternative intersection controls (i.e. traffic signals or roundabouts). The review also found that traffic flow increase between 2021 and 2031 is much less than that between 2011 and 2021, and therefore with appropriate design (i.e. the intersection upgrades and the widening of Picton Road between the western access and Hume Highway) required by 2021 should cater for 2031 traffic flows.

It is noted that the Wilton Junction development has proposed a number of transport initiatives to mitigate traffic generation, comprising fostering and supporting work-from home employment, attraction of professionals to live and work in Wilton, and realisation of public transport options including bike paths, bus routes and rail transport.

Traffic impacts on air quality are related to various factors including traffic volumes and average speeds on roads, vehicle type and how regularly vehicles are maintained, fuel type and quality, and road design.

6.4 Statement of Environmental Effects, STP and Effluent Reuse Scheme – Wilton Parklands Development (2005)

The Statement of Environmental Effects document was prepared by CH2M Hill on behalf of Delfin Lend Lease Ltd and Bradcorp Holding Pty Ltd in support of a development application to Council to provide an STP and treated effluent reuse system capable of receiving and treating sewage from the proposed 1,165 residential lots on the Bingara George development site.

The proposed integrated water management system includes:

- A STP located in the south-western corner of the Wilton Parkland site with one or more SPS to transfer sewage to the STP.
- The system will utilise flow equalisation, screening followed by a Membrane Bio-Reactor (MBR) plant incorporating biological nutrient removal enhanced by chemicals, with hypochlorite disinfection, residual chlorination and phosphorus removal to treat wastewater to a quality suitable for reuse.
- A treated effluent reuse scheme to use treated effluent as irrigation water (i.e. for golf courses, parks, road verges) and non-potable uses (i.e. toilet flushing, garden watering) on residential lots.
- A stormwater management system.

The MBR type plant is preferred over an intermittent type plant given the high treatment capability, low odour generating potential, and the ability for the plant to be integrated successfully with other site development. A 250 metre (m) buffer zone is to be maintained between the STP specifically and residential land uses area proposed for the Wilton Parklands development, as determined by qualitative and quantitative assessments prepared by CH2M Hill and supported by VIC EPA 1990 guidance for biological wastewater plant with an equivalent population of less than 5,000 (refer to **Section 4.6**), and the NSW Environmental Planning and Assessment Regulation 2002. The odour impact assessment predicted concentrations of odours at the 250 m buffer zone surrounding the STP to be 0.5 odour units (OU as the 99th percentile results).

The location and design of each SPS will consider wet well submersible designs for location within 100 m of an existing or proposed residential area and the distance of the proposed SPS from the closest residential boundary.

Likely predominant odour sources and proposed odour controls are outlined below:

- Inlet works will be enclosed and air to be extracted and treated by odour control device prior to release to atmosphere.
- Screenings and grit bins will be housed within an enclosed building and the air extracted to an odour control device. Doors are to remain closed except during removal and replacement of bins.
- Biosolids holding tanks will generate odours during storage and so the headspaces of the tanks will be connected to odour control devices.
- Biosolids pumping and transfer may generate release of odour from road tankers. During pumping the inspection hatches will be connected to an odour control device via a hose. The connection will allow for displaced vapours from tankers to be placed back to the storage tank headspace, where they would be captured and treated by an odour control device.
- The odour control system will comprise an organic media biofilter which are able to achieve high efficiency removals of odorous compounds including hydrogen sulphide and VOCs.

It is noted that at the time of writing this reporting, the Bingara Gorge are in the process of moving from a temporary STP to a full MBR.

6.5 Wilton Junction Rezoning - Wastewater Strategy (2013)

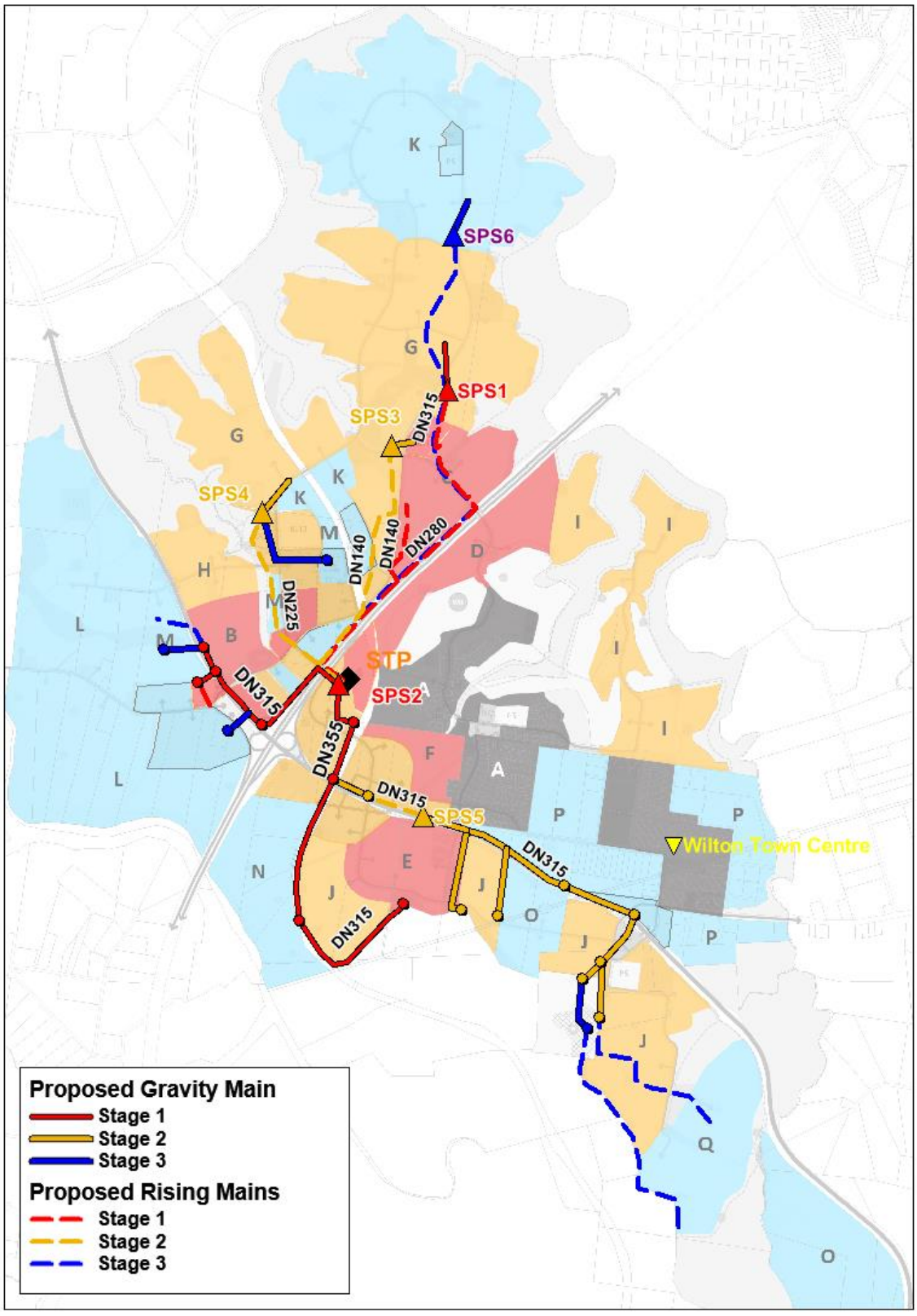
The Wastewater Strategy prepared by MWH Global in October 2013 provides information on the wastewater scheme proposed for the Wilton Junction development which proposes to locate a new wastewater treatment plant (WWTP) with tertiary media filters alongside the existing Bingara Gorge STP.

The strategy comprises a concept level plan for the WWTP comprising primary, secondary and tertiary treatment, and a distribution network. A pressure sewer scheme is the preferred wastewater network for the development and as such is expected to have minimal wet weather inflow or infiltration (refer to **Figure 4**). A review of the potential options for bio-solids treatment and beneficial reuse/disposal options has also been performed. The approach of the treated effluent disposal strategy is to maximise land irrigation with the remainder going to a purpose built lake prior to any eventual return to the environment.

It is noted that one of the servicing options which may be available to the Project is to integrate the wastewater networks and upgrade the Bingara Gorge STP to service the initial stages of the Wilton Junction development which would reduce the overall flow to the proposed Wilton Junction STP as well as the size of the STP and associated costs.

The total dwelling production at ultimate development (Wilton Junction and Bingara Gorge) is expected to be 11,900 of which 1,800 will be associated with the Bingara Gorge development. The Wastewater Strategy assumes that Bingara Gorge will be serviced by the existing (or upgraded) STP, distribution networks and effluent disposal system, and the Project will be serviced by a new stand-alone WWTP and distribution network.

Figure 4 Preferred Wastewater Strategy for the Project



Source: MWH Global

7 RISK ASSESSMENT METHODOLOGY

A *qualitative* risk-based assessment has been carried out according to the methodology detailed below.

7.1 Overall Approach

Predictions of air quality impacts are necessary when appraising potential future impacts on potentially sensitive land uses. Specific methodologies are described in further detail in the relevant sections of this document, however the following broad "risk based" approach has been adopted for each study area.

Existing industries with potential to emit air pollutants both within and surrounding the subject land were identified through review of publicly available EPL and NPI database information and previous Environmental Impact Assessment documentation where available. Air polluting industries likely to make up part of the Wilton Junction Precinct were also identified in consultation with Elton Consulting. For each industry, a *qualitative* risk-based impact assessment was undertaken of potential air quality impacts to identify a range of suitable control measures available to mitigate those impacts.

The assessment criteria for receptor sensitivity (see **Section 7.3**), impact magnitude (see **Section 7.4**) and the resultant impact significance (see **Section 7.5**) have been developed by SLR.

The risk-based assessment takes account of a range of impact descriptors, including the following:

Nature of impact	Is the impact anticipated to result in an adverse or beneficial effect on the receiving environment?
Receptor Sensitivity	How sensitive is the receiving environment to the anticipated impacts?
Magnitude of Impact	What is the anticipated scale of the impact?

The integration of sensitivity with impact magnitude is used to derive the predicted significance of that impact, and may be adverse or beneficial in nature.

These terms, and the qualifying justification for each attributed value are described below.

7.2 Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment. Terms such as "positive" and "negative" are not used to avoid complication (i.e. a positive increase in air pollutant concentration would have a negative impact, for example):

Beneficial	The predicted impact will cause a beneficial effect on the receiving environment.
Neutral	The predicted impact will cause neither a beneficial nor adverse effect.
Adverse	The predicted impact will cause an adverse effect on the receiving environment.

7.3 Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. For example, a receptor may be determined to have varying sensitivity to different environmental changes (i.e. high sensitivity to changes in air quality, but low sensitivity to noise impacts, for example). Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Table 7 outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table 7 Methodology for Assessing Sensitivity of a Receptor

Sensitivity	Description	Examples
Very High	Receptors are highly sensitive to changes in air quality	Background concentrations are above 90% of the air quality criterion. Receptors of very high sensitivity to air pollution such as: hospitals and clinics, retirement homes, painting and furnishing, hi-tech industries and food processing.
High	Receptors have a high sensitivity to changes in air quality	Background concentrations are between 75% and 90% of the air quality criterion. Receptors of high sensitivity to air pollution such as: schools, residential areas, food retailers, glasshouses and nurseries, horticultural land and offices.
Medium	Receptors have a medium sensitivity to changes in air quality	Background concentrations are between 50% and 75% of the air quality criterion. Receptors of medium sensitivity to air pollution, such as: farms, outdoor storage, light and heavy industry.
Low	Receptors have a low sensitivity to changes in air quality	Background concentrations are below 50% of the air quality criterion. All other air quality sensitive receptors not identified above.

7.4 Magnitude

Magnitude describes the anticipated scale of the predicted environmental change in terms of how that impact may cause a change to existing (baseline) conditions, and may be described quantitatively or qualitatively. Where an impact is defined by qualitative assessment, suitable justification is provided in the text.

Table 8 Magnitude of Impacts

Magnitude	Description	Examples
Substantial	Impact is predicted to cause significant consequences on the receiving environment.	Substantial risk that the impacts will generate nuisance complaints, resulting in regulatory action.
Moderate	Impact is predicted to possibly cause statutory objectives/standards to be exceeded.	Moderate risk that the impacts will generate nuisance complaints, resulting in regulatory action.
Slight	Predicted impact may be tolerated.	Slight risk that the impacts will generate nuisance complaints, resulting in regulatory action.
Negligible	Impact is predicted to cause no significant consequences.	Negligible risk that the impacts will generate nuisance complaints, resulting in regulatory action.

7.5 Significance

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table 9 Impact Significance Matrix

Sensitivity \ Magnitude		[Defined by Table 8]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table 7]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

It is noted that the above approach is designed to provide an overall impact risk, and is not the defining determination for the requirement for mitigation and control. Impacts with a lower determined significance should also be minimised wherever possible.

The approach also may underestimate the impact significance in environments which are assessed as having low sensitivity to impacts of a substantial or moderate magnitude, and therefore a pragmatic approach to the assessment significance should be applied.

Any impacts identified as having a substantial magnitude should receive detailed appraisal of mitigation options. Refer to **Section 9** for a preliminary risk assessment and **Section 11.6.3** for a reappraisal of the potential impacts (i.e. residual impacts) associated with each site where mitigation measures are applied.

8 EXISTING ENVIRONMENT

8.1 Background Air Quality Monitoring Data

The OEH operate a number of air quality monitoring stations to measure key air pollutants in the region and to evaluate compliance with air quality goals.

The Bargo monitoring site was commissioned in January 1996 and is still active. The site is located approximately 11 km to the south-west of the Project site on residential property in a rural area on the far south-west edge of the Sydney basin and is at an elevation of 365 m Australian Height Datum (AHD). Air pollutants currently measured at Bargo include ozone, NO_X, SO_2, and particulates (as PM_{10}).

CO and $PM_{2.5}$ are not measured at the Bargo monitoring site, therefore 24-hour average background measurements of CO and $PM_{2.5}$ have been provided for the OEH's Liverpool monitoring site. The Liverpool monitoring station was commissioned in 1990 and is still active. This monitoring site is located approximately 36.5 km to the north-east of the Project site in a mixed residential/commercial area and is at an elevation of 22 m AHD.

Measurements of the above air pollutants are also presented graphically for the OEH's Macarthur monitoring station for comparison to the Bargo and Liverpool monitoring results, where available. It is noted that the Macarthur monitoring station was decommissioned in August 2012. This station was located approximately 17.5 km to the north-east of the Project site in a residential/semi-rural area at an approximate elevation of 105 m AHD.

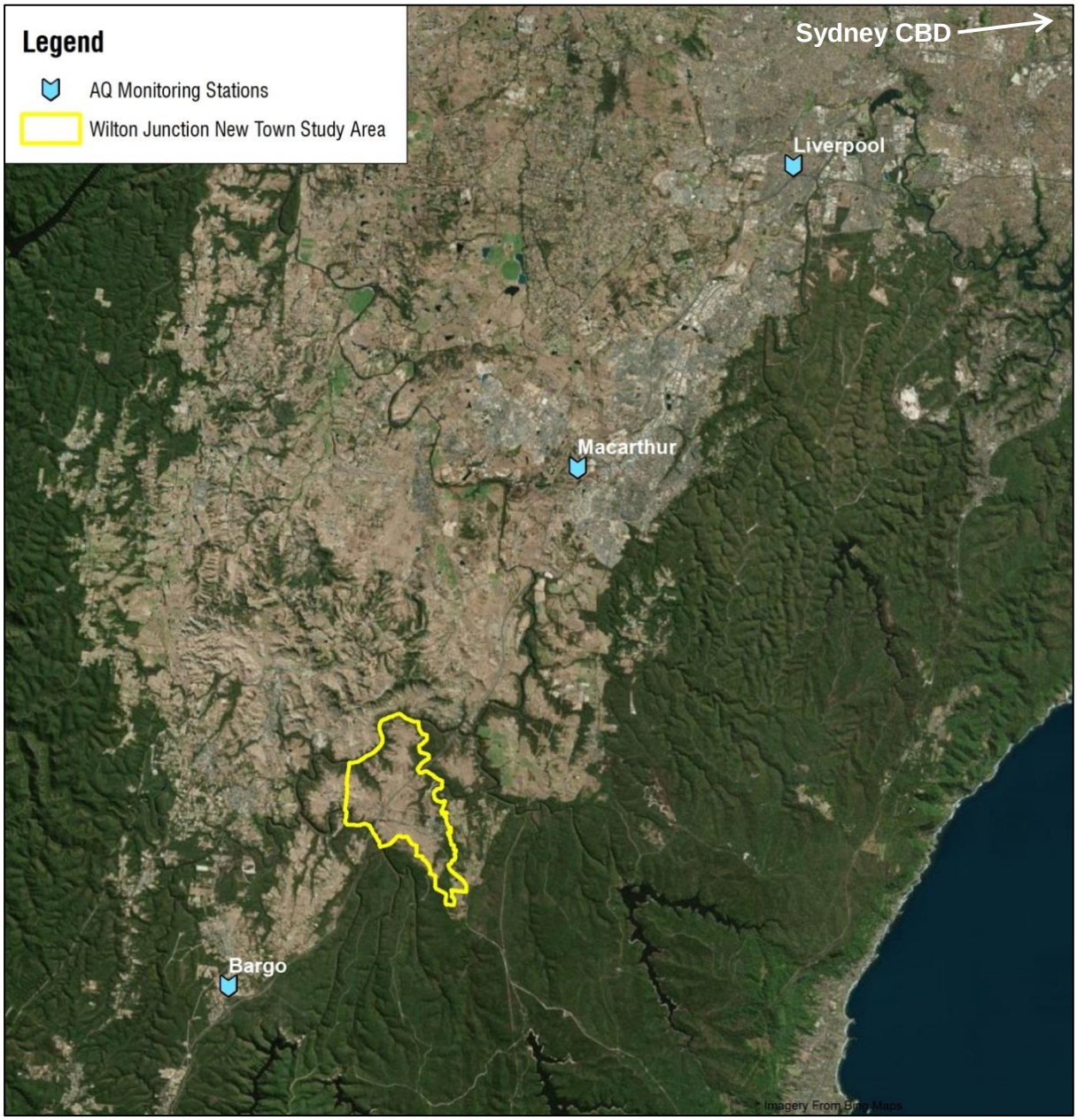
The relative locations of all three air quality monitoring stations to the Wilton area are shown in **Figure 5**.

Monitoring results available online for the last 5 years (1 January 2007 to 31 December 2012) are presented graphically for comparison to relevant EPA air quality standards. Analysis of the background monitoring data indicates that levels of ozone and particulate are potential air pollutants of concern in the Wilton local area, while levels of NO_2, CO, and SO_2 are shown to be considerably less than their respective EPA guideline values for all years.

It is noted that the 24-hour average concentrations of PM_{10}, $PM_{2.5}$ and SO_2 are presented for direct comparison to reporting standards (or advisory standard in the case of $PM_{2.5}$). However, daily maximum concentrations (and not concentration relevant to standard averaging periods) are presented for ozone, NO_2, CO, and SO_2. For these pollutants, air quality standards have been provided for reference only.

The monitoring results demonstrate that measured levels of ozone and PM_{10} are similar for the Macarthur and Bargo monitoring stations, however a greater number of exceedances of the relevant air quality criteria are measured at the Macarthur monitoring station than at the Bargo monitoring station, as would be expected given the locations of each station relative to Wilton and the Sydney CBD.

Figure 5 Relative Locations of Air Quality Monitoring Stations to the Project Site



8.1.1 Ozone

Maximum daily 1-hour average and 4-hour rolling average concentrations measured at Bargo and Macarthur over the 5 year period (2007 to 2012) are presented in **Figure 6** and **Figure 5** and compared to relevant EPA criteria. The graphs show that highest ozone levels were measured during the warmer months of the year.

The Bargo monitoring station measured 14 exceedances of the 1-hour average criterion and 35 exceedances of the 4-hour rolling average criterion, while the Macarthur monitoring station measured 19 exceedances of the 1-hour average criterion and 36 exceedances of the 4-hour rolling average criterion during the 5 year monitoring period. The majority of exceedances were measured during the warmer months of 2009.

Figure 6 Daily Maximum 1-hour Average Ozone Concentrations – Bargo & Macarthur Sites

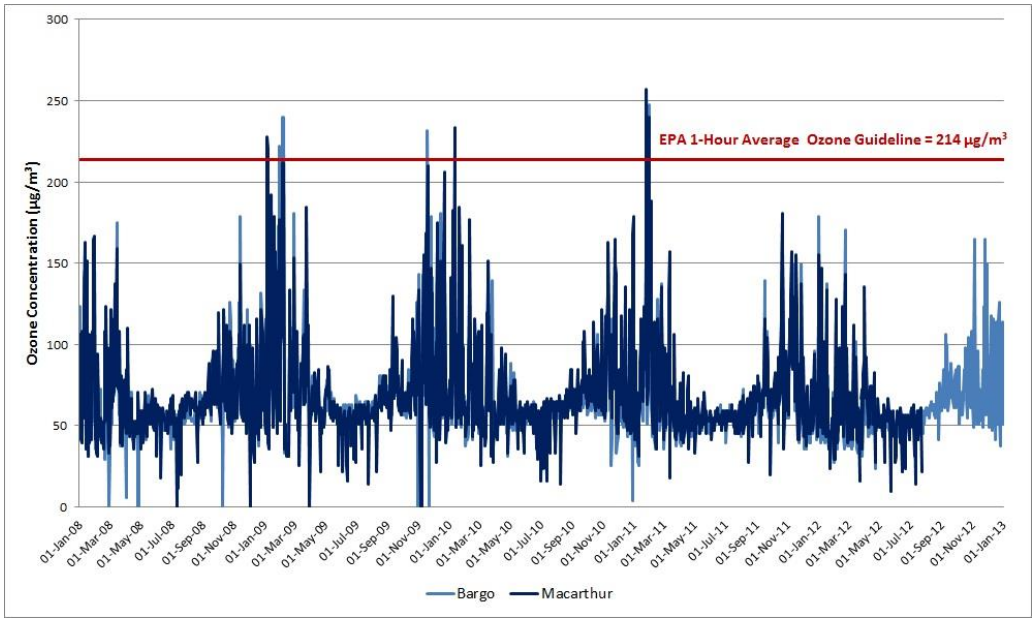
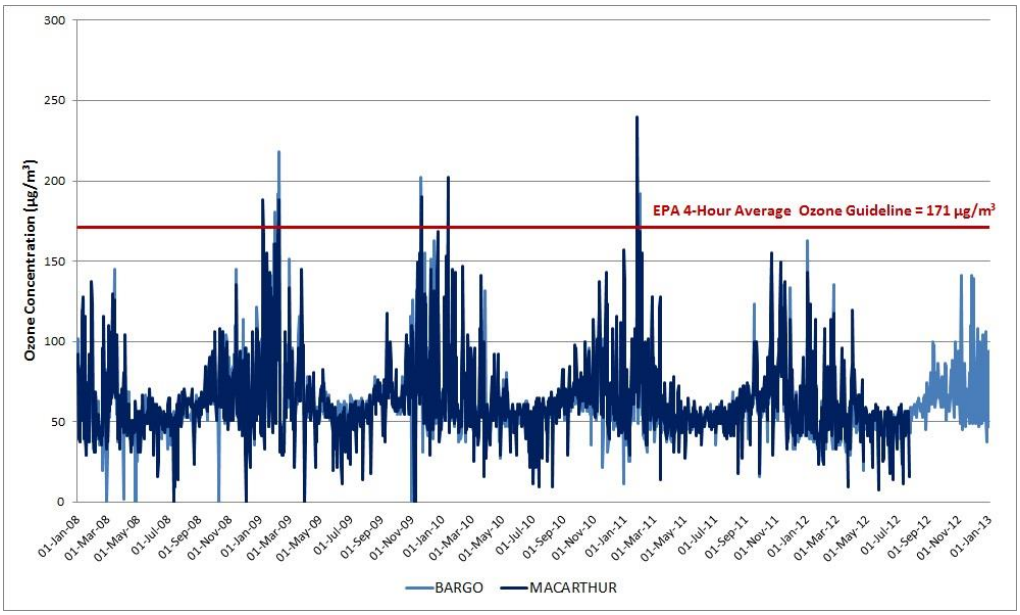


Figure 7 Daily Maximum 4-hour Average Ozone Concentrations – Bargo & Macarthur Sites

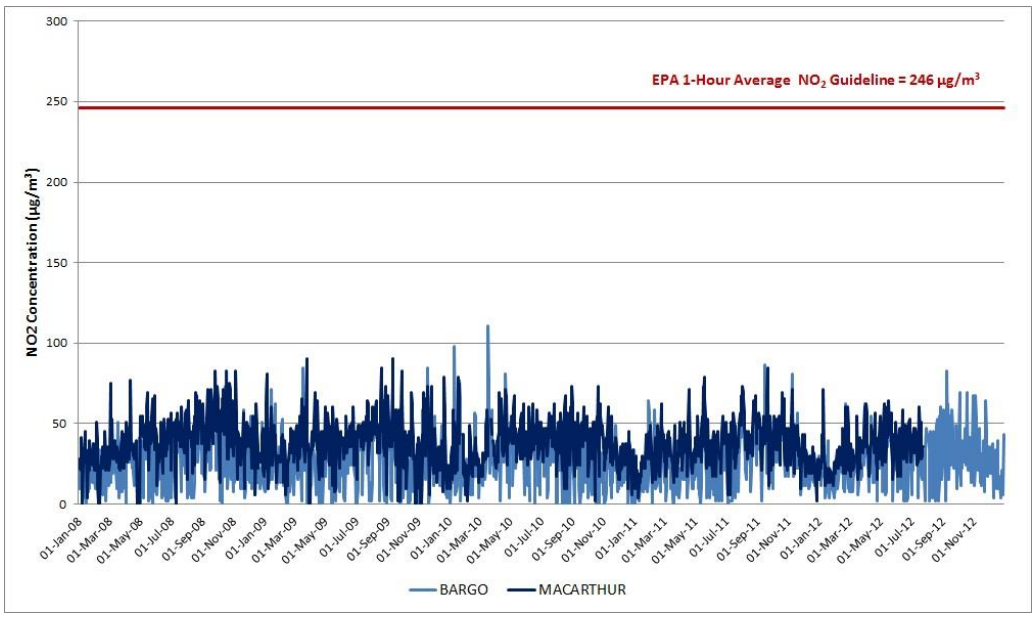


8.1.2 Nitrogen Dioxide (NO_2)

Maximum daily 1-hour average NO_2 concentrations measured at Bargo and Macarthur over the 5 year period (2007 to 2012) are presented in **Figure 8** and compared to the EPA 1-hour average guideline. The maximum daily 1-hour average NO_2 concentrations measured at Bargo are shown to be typically less than 100 µg/m^3.

No exceedances of the relevant criterion occurred during the 5 year monitoring period.

Figure 8 Daily Maximum 1-Hour Average NO_2 Concentrations – Bargo & Macarthur Sites

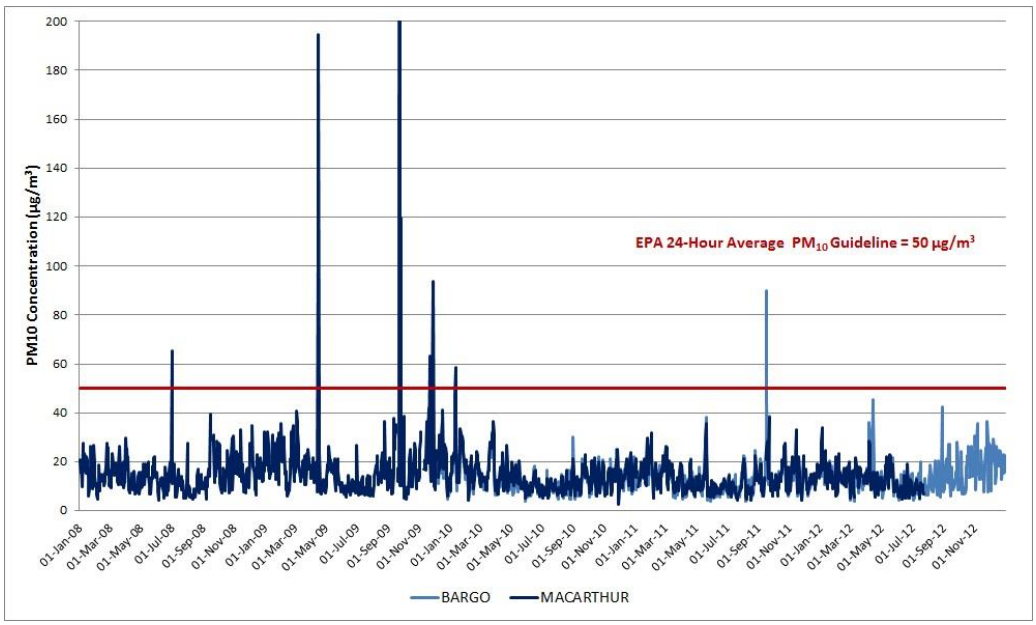


8.1.3 Particulate Matter (as PM_{10})

The 24-hour average PM_{10} concentrations measured at Bargo and Macarthur over the 5 year period (2007 to 2012) are presented in **Figure 9** and compared to the EPA 24-hour average criterion. It is noted that PM_{10} monitoring data for the Bargo monitoring station is not available between 1 January 2008 and 3 December 2009.

Concentrations are shown to exceed the relevant criterion on 1 occasion for the Bargo monitoring station and 9 occasions for the Macarthur monitoring station. The National Environment Protection Measure (NEPM) allows for 5 exceedances per year. Macarthur monitoring station measured 7 exceedances of the 24-hour average PM_{10} criterion in 2009. Some of these exceedances may be attributed to a severe dust storm experienced in Sydney in late September 2009.

Figure 9 24-Hour Average PM_{10} Concentrations – Bargo & Macarthur Sites

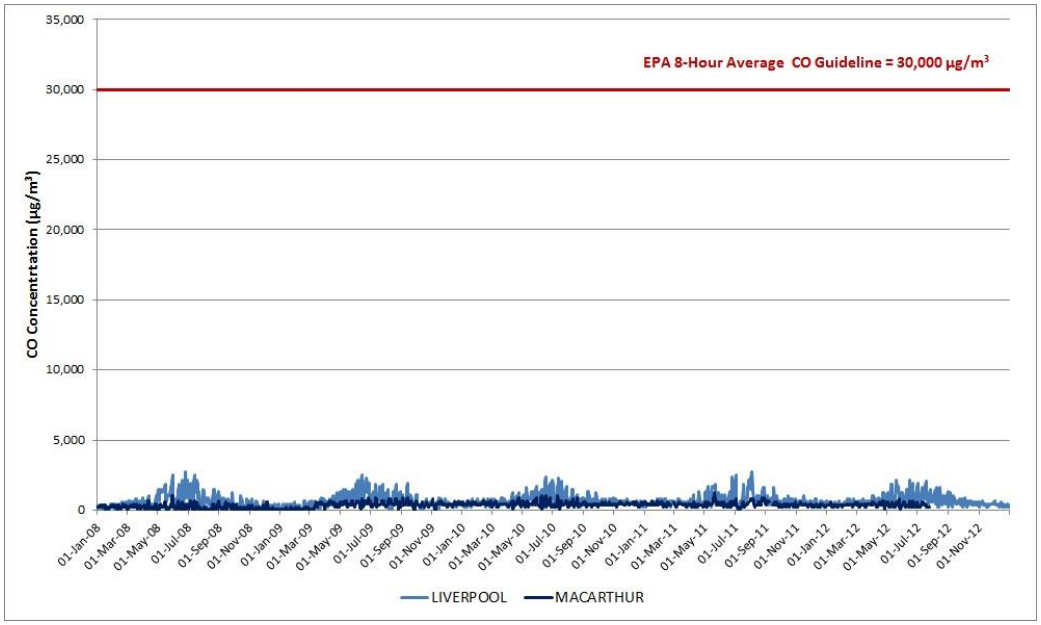


8.1.4 Carbon Monoxide

Maximum daily 1-hour average CO concentrations measured at Bargo and Macarthur over a 5 year period (2007 to 2012) are presented in **Figure 9** and compared to the EPA 24-hour average criterion. Maximum daily concentrations are shown to lie well below the relevant criterion.

No exceedances of the relevant criteria occurred during the 5 year monitoring period.

Figure 10 Daily Maximum 8-Hour CO Concentrations – Liverpool & Macarthur Sites



8.1.5 Sulphur Dioxide

Maximum daily 1-hour average SO_2 concentrations and 24-hour average SO_2 concentrations measured at Bargo over a 5 year period (2007 to 2012) are presented in **Figure 9** and

Figure 12 and compared to the EPA 1-hour and 24-hour average criteria. Concentrations are shown to lie well below the relevant criteria.

No exceedances of the relevant criteria occurred during the 5 year monitoring period.

Figure 11 Daily Maximum 1-Hour Average SO_2 Concentrations – Bargo & Macarthur Sites

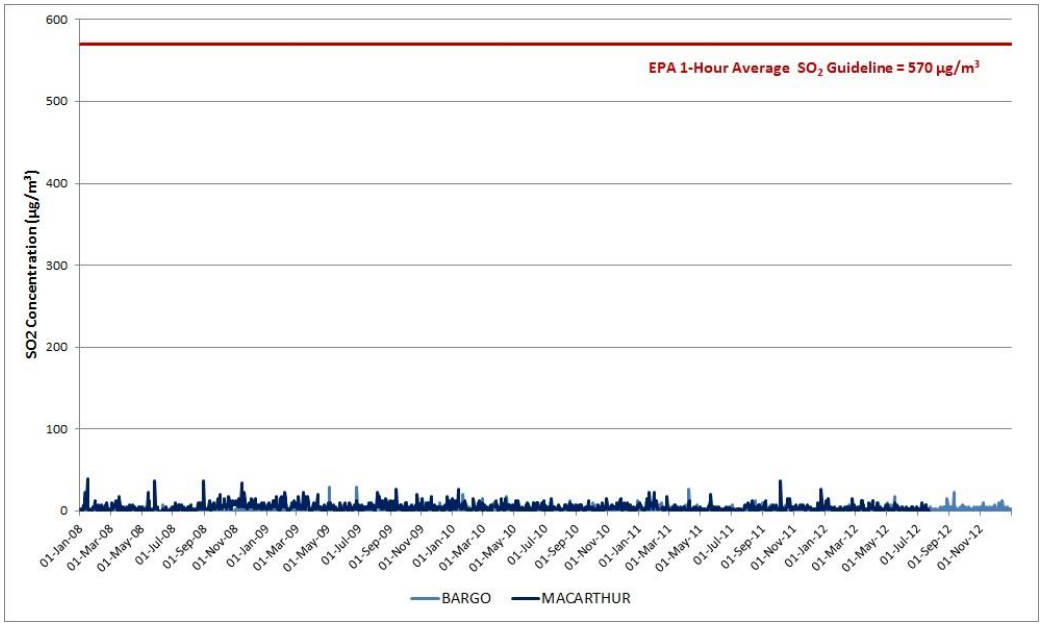
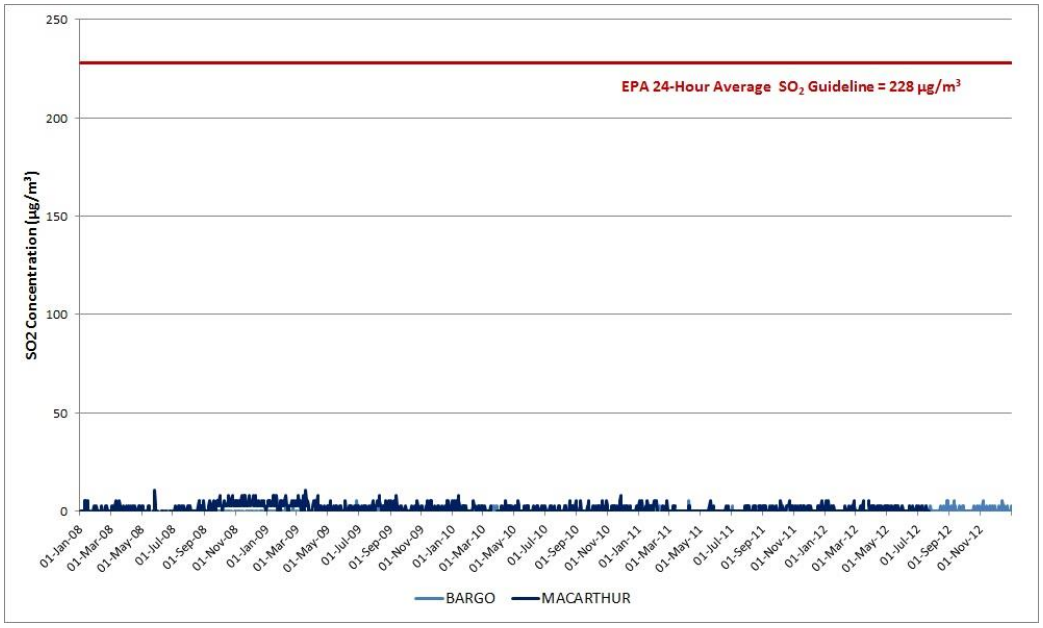


Figure 12 24-Hour Average SO_2 Concentrations – Bargo & Macarthur Sites

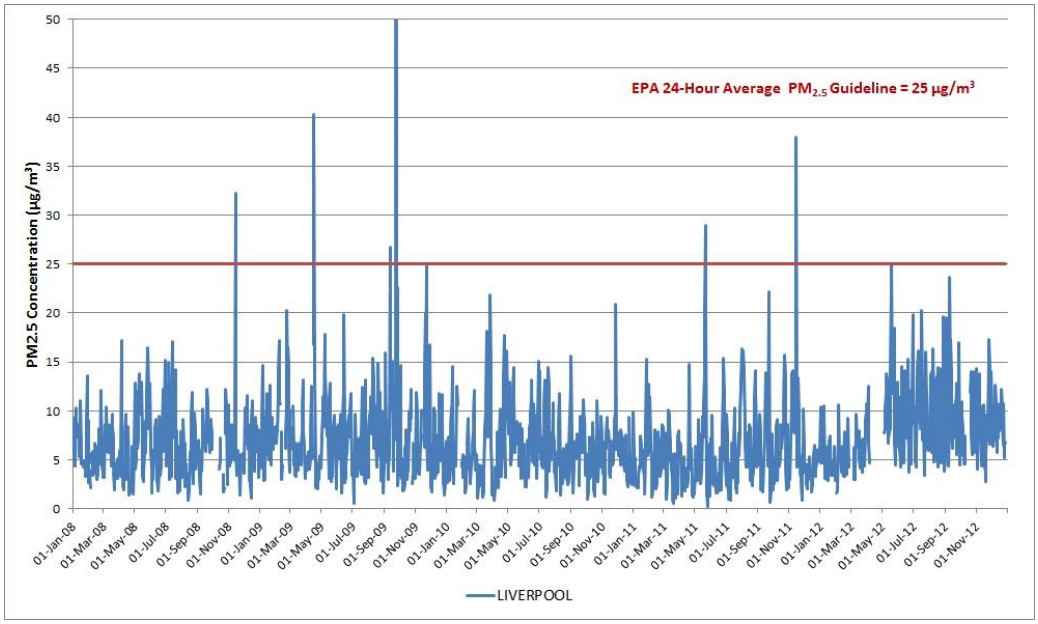


8.1.6 Particulate Matter (as $PM_{2.5}$)

24-hour average $PM_{2.5}$ concentrations measured at Liverpool over a 5 year period (2007 to 2012) are presented in **Figure 13** and compared to EPA 24-hour average advisory reporting standard. A total of 6 exceedances are shown to occur during the monitoring period.

It is noted that monitoring results for Liverpool have been provided for reference only and may not representative of the situation in the local Wilton area. It is further noted that the 25 µg/m^3 criterion is an advisory reporting standard, and there is currently no air quality standard set for $PM_{2.5}$ in Australia.

Figure 13 24-Hour Average $PM_{2.5}$ Concentrations – Liverpool Site



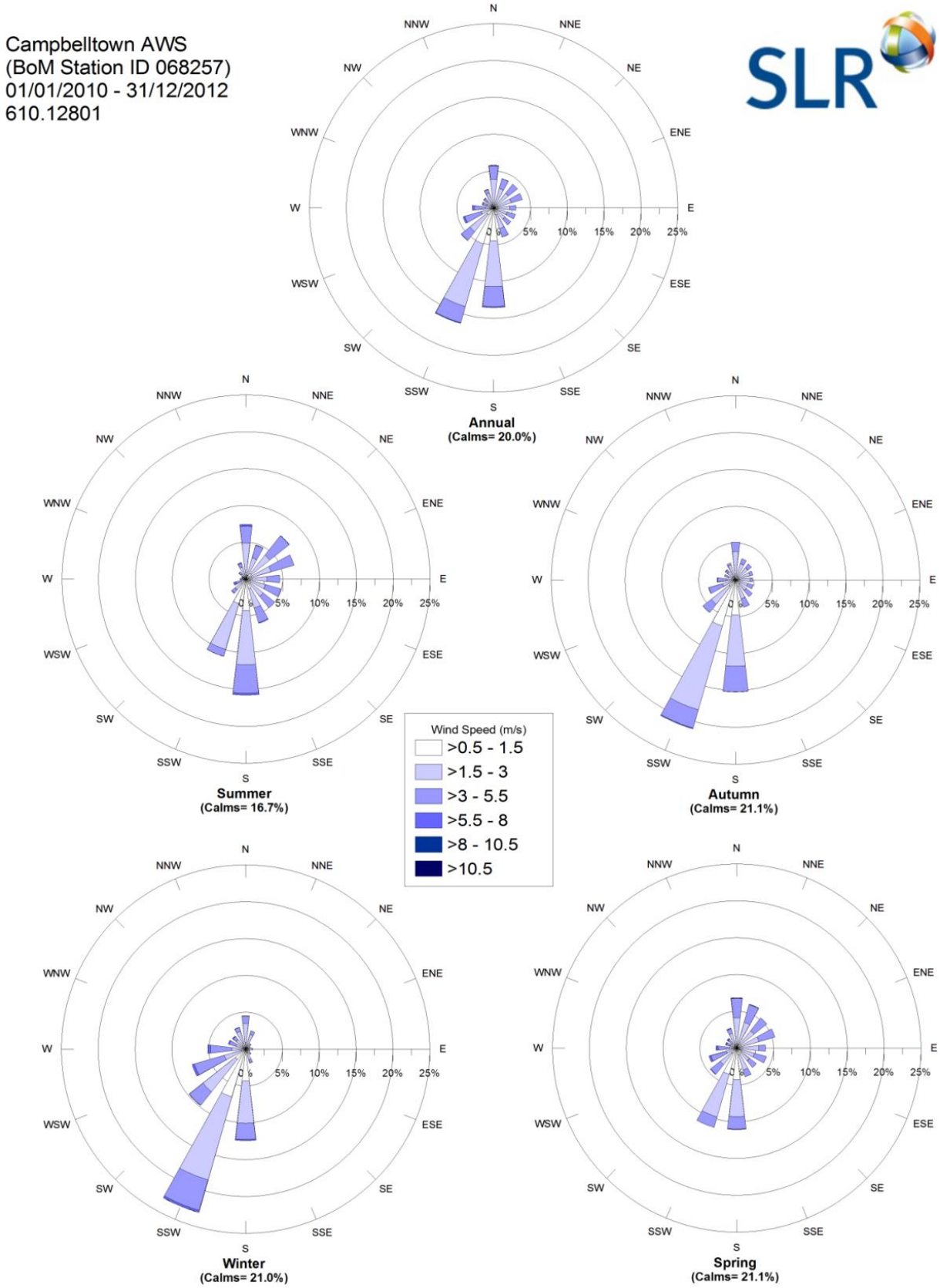
8.2 Prevailing Wind Conditions

No site-specific meteorological monitoring data is available for the Wilton local area. For the purposes of this assessment, prevailing wind conditions for the region incorporating the subject land was characterised using data obtained from closest Bureau of Meteorology (BoM) automatic weather stations (AWS) which was identified as Campbelltown (Mount Annan) AWS (Station Number 068257) located approximately 20.9 km to the north north-east of the Project site.

Annual and seasonal wind roses (i.e. plots of wind speed and wind direction) have been generated and are presented in **Figure 14**.

The annual wind rose shows predominately light to fresh winds (between 1.5 m/s and 10.5 m/s) from the south south-west and south quadrants are typically experienced by the region and occur approximately 16% and 13% of the time during the year respectively. Calm wind conditions (wind speed less than 0.5 m/s) occur at an average of approximately 20% of the time during the year. Calm wind conditions may result in poor dispersion of air pollutants, but may conversely result in lower rates of pollutant emission as a result of wind scouring.

Figure 14 Wind Roses – Campbelltown AWS



Seasonal wind roses indicate the following:

- In the summer, predominant winds are experienced from the south approximately 15% of the time.
- In the autumn, predominant winds are experienced from the south south-west and the south approximately 20% and 15% of the time respectively.
- In the winter, predominant winds are experienced from the south south-west approximately 23% of the time.
- In the spring, predominant winds are experienced from the south and south south-west approximately 12% of the time each.

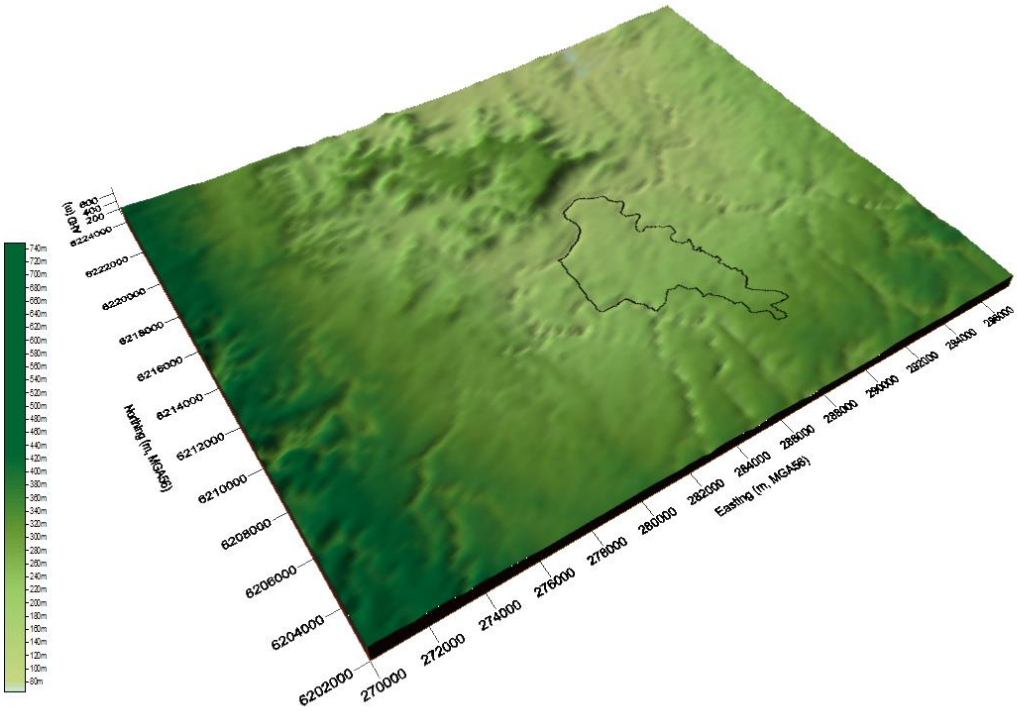
8.3 Topography

Topography is important in air quality studies as local atmospheric dispersion could be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channeling effects in valleys or gullies around the Project site.

A three dimensional representation of the area is given in **Figure 15**. The topography of the Project site increases in a north-south direction from an approximate elevation range of 100 m to 300 m Australian Height Datum (AHD).

It is noted that the transportation of ozone and air pollution with the north-east sea breeze is anticipated to be less effective with distance south west, particularly given the reasonably steep terrain existing between Campbelltown and Wilton. It is also expected that at night, cold air drainage down the southern highlands would generally flush the Wilton area with clean air from further south-west, providing improved air quality (SKM 2000).

Figure 15 Topography of the Local Area



Note: Vertical exaggeration applied.

8.4 Sensitive Receptors

Hospitals, specialist clinics and medical centres may make up part of the proposed Town Centre Precinct, Mixed Use Precinct, Neighbourhood Centre Precinct and Enterprise 1 and 2 Precincts. A medical centre is also planned for the Highway Services Precinct. Hospitals, clinics and medical centres are highly sensitive to changes in air quality.

Precincts featuring primarily residential land uses include the Residential Precinct and the Medium Density Residential Precinct. The Town Centre and Mixed Use Precincts will also comprise some medium density housing and mixed residential/commercial land uses. Sensitive land uses other than residences include child care centres, schools, offices, parks and other recreational land uses.

Reference should be made to the Wilton Junction Master Plan in **Figure 3** for further information on the proposed locations of sensitive receptors.

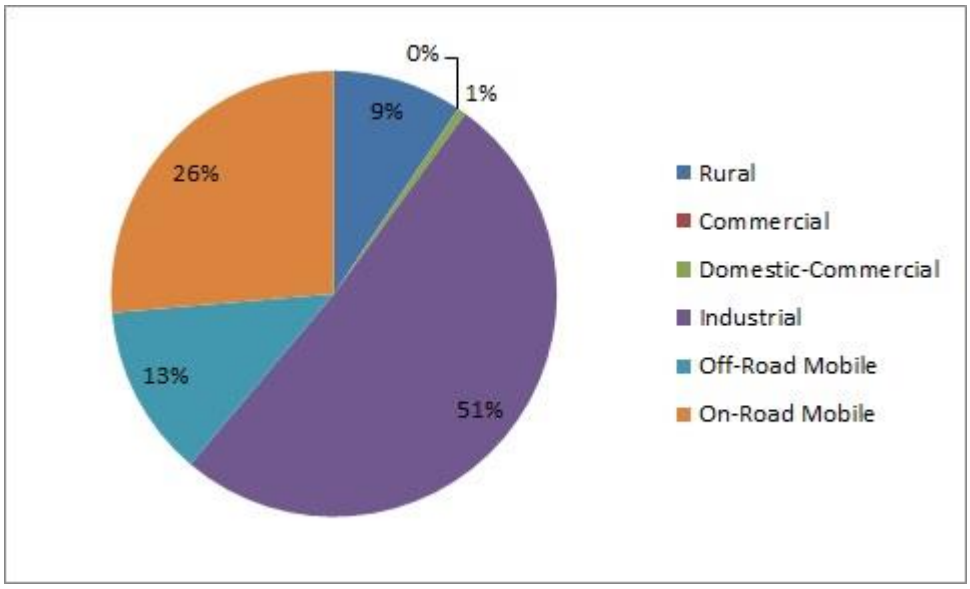
8.5 Emissions Estimate for the Wollondilly LGA

Appendix C presents selected air emissions data compiled from EPA's Emissions Inventory returns for the Wollondilly LGA, which encompasses the proposed development. The emissions are presented along with the significant sectoral contributors to that total (i.e. rural, commercial, domestic/commercial, industrial, on- and off-road mobile sources). These data are presented to establish the regional emissions inventory for pollutants emitted from the local area, and also establish the significance of sources to that total.

The relative sectoral contributions of key pollutants are presented in **Figure 16**, **Figure 16** and **Figure 17** below. The domestic/commercial contribution to total VOCs is shown in more detail in **Figure 18** to allow for clear distinction between the other sectoral contributions to the total.

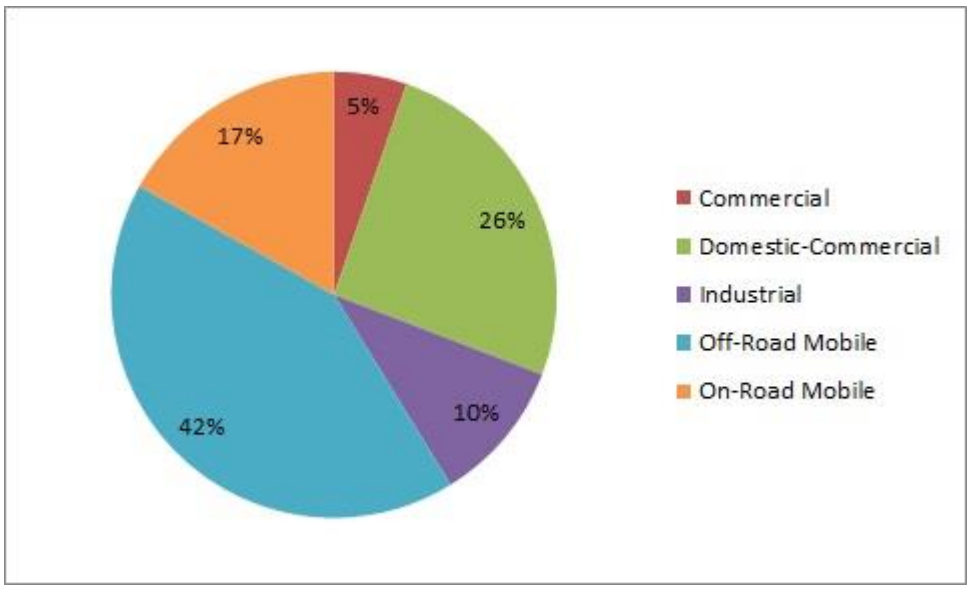
The data shows that industrial sources are the largest contributors of NO_X and PM_{10} to the Wollondilly LGA, with commercial and off-road mobiles also contributing significant amounts of NO_X to the sectoral total. With the exception of rural sources, on-road and off-road mobile sources and domestic/commercial sources are the largest contributors of total VOCs to the Wollondilly LGA.

Figure 16 Sectoral Contributions of NO_X



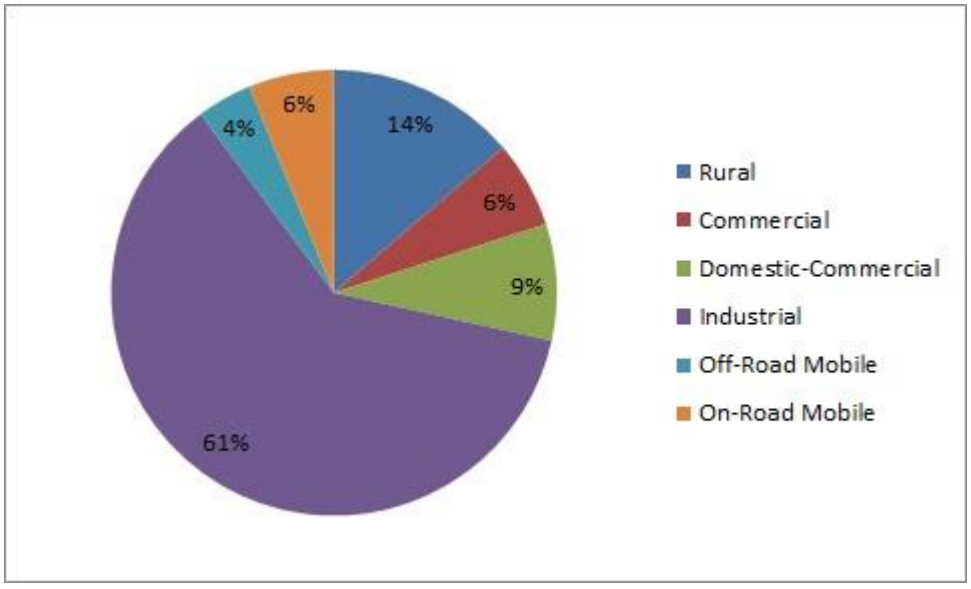
The emissions data shows that the generation of electrical power from gas is the largest industrial source of NO_X to the Wollondilly airshed.

Figure 17 Sectoral Contributions of Total VOCs



Review of the off-road mobile data shows that recreational boats represent 95% of total off-road mobile VOC emissions to the Wollondilly airshed.

Figure 18 Sectoral Contributions of PM_{10}



The emissions data shows that coal mining, crushing, grinding and separating, and cement/lime production industries are significant sources of PM_{10} to the industrial sector within the Wollondilly LGA.

Figure 19 Breakdown of Domestic/Commercial Contributions of Total VOCs

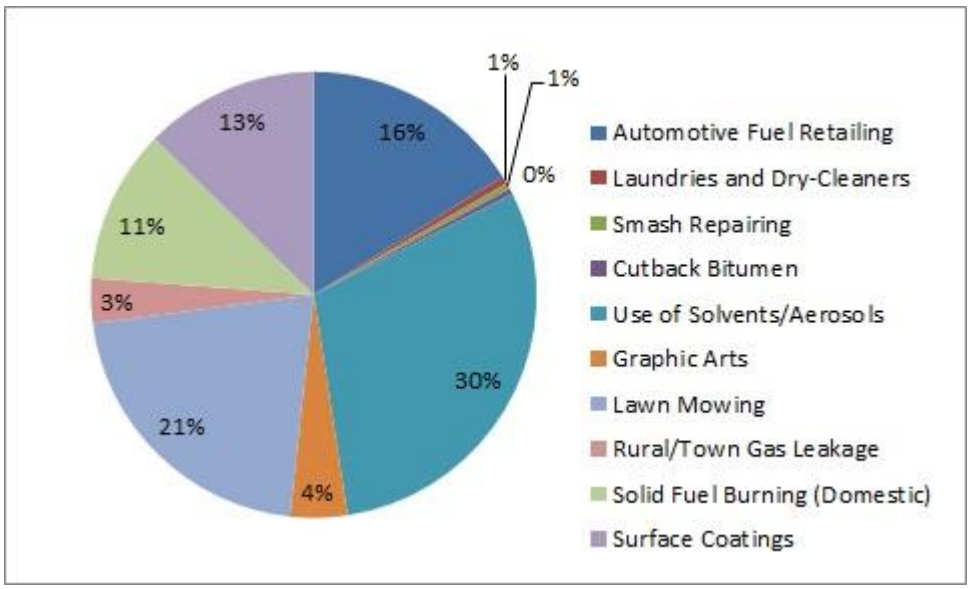


Figure 19 demonstrates that the use and storage of solvents/aerosols, lawn mowing (evaporative and exhaust-related), automotive fuel retailing, surface coatings and domestic solid fuel burning are sizeable contributions of VOCs to the domestic/commercial sector within the Wollondilly LGA.

9 RISK ASSESSMENT

This section provides the high level assessment of the potential risks at non-location specific sensitive receptors (i.e. residences, schools etc) proposed for the Project. The impact assessment uses the methodology presented in **Section 7** of this report. In the context of this methodology, the resultant risk is termed "*impact significance*".

9.1 Receptor Sensitivity

In terms of the methodology in **Section 7**, the sensitivity of proposed residences, schools and offices to potential air quality impacts should be considered to be ***high***.

The sensitivity of proposed hospitals, medical centres and retirement homes to potential air quality impacts should be considered to be ***very high***.

9.2 Potential Impacts Associated with Existing and Future Off-site Sources

9.2.1 Wilton Quarry

Wilton Quarry is located at 155 Wilton Road, Wilton. Information on the quarry has been collated from the "*Preliminary Environmental Assessment* (PEA) - *Wilton Quarry"* (2008) document prepared by Walker Corporations Pty Ltd.

The total site area is 8.6 ha however it is noted that approximately half of this area had been actively used as a quarry at the time of reporting. The quarry features highest grade sandstone typically used for heritage restoration works. Proposed future operations comprise an increase in the volume of extraction (and not the area of extraction) and based on the proposed extraction rate the quarry would have an estimated life of 20 years. Activities involved in the extension of operations would include excavation works and crushing of overburden for road base on site.

The quarry is located approximately 1.8 km east of the Project site boundary which meets the VIC EPA recommended separation distance of 500 m for a quarry (capable of generating respirable crystalline silica). In addition, an existing vegetated buffer of approximately 150 m surrounds the quarry site. Prevailing wind conditions are also not likely to transport pollutants toward the direction of the Project site.

Given the above information, the impact due to quarrying operations to the east of the Project site is considered to be ***negligible*** (i.e. the impact is predicted to cause no significant consequences). Correspondingly, the impact significance should be considered to be ***neutral*** (refer to **Table 10**).

Table 10 Impact Significance – Wilton Quarry

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.2.2 Surrounding Poultry Farm Operations

A Level 1 Odour Impact Assessment has been performed for all identified poultry farms (refer to **Section 5.2.2**) in accordance with relevant EPA odour policy. The calculated separation distances are provided in **Table 11** and the full Level 1 Impact Assessment is presented as **Appendix B**.

Table 11 Level 1 Odour Impact Assessment – Recommended Separation Distances

Location	Existing Separation Distance (m)	Level 1 Separation Distance (m)	Odour Constraint? (Y/N)
Ashwood Road, Wilton (1 Farm)	895	409	N
Pheasant Nest Road (2 Farms)	2,840	2,048	N
Cross St, Maldon (2 Farms)	3,440	599	N
Koorana Road, Maldon (1 Farm)	3,620	588	N
Appin Rd, (Inghams Complex)	7,040	2,905	N

Given the results of the above screening assessment, the impact due to poultry farm operations surrounding the Project site is considered to be ***negligible*** (i.e. the impact is predicted to cause no significant consequences). Correspondingly, the impact significance should be considered to be ***neutral*** (refer to **Table 12**).

Table 12 Impact Significance – Surrounding Poultry Operations

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.2.3 Picton Sewerage Scheme Expansion

As noted in **Section 5.2.3**, the Picton Sewerage Scheme is set to expand operations to allow additional connections to seven growth areas on the outskirts of Picton, Tahmoor, and Thirlmere located to the west and north-west of the Project site.

The closest SPS would be located approximately 4 km to the west of the Project site and therefore the magnitude of odour emissions due to expansion works on sensitive receptors planned for the development is considered to be ***negligible***. Correspondingly, the impact significance should be considered to be ***neutral*** (refer to **Table 13**).

Table 13 Impact Significance – Picton Sewerage Scheme Expansion

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.2.4 Additional Surrounding Industries

A number of major industry types surrounding the Project site have identified however all identified industries are located at distances greater than 1,000 m (i.e. 1 km) from the proposed Project site boundary and meet their respective VIC EPA recommended separation distances, where applicable. The closest power station to the Project site is the Tower Coal Seam Methane Power Station located approximately 2 km east from the Project boundary.

Large industries generating potentially significant emissions to air, such as power stations, coal mining operations and cement manufacturers, are regulated by the EPA through ongoing EPL requirements. The majority of identified industries are also required to report to the NPI. In addition, dense wooded vegetation currently exists between the identified off-site industries and the Project site, and have been retained in the Wilton Junction Master Plan (refer to **Figure 3**). Vegetated buffers can effectively act to increase mechanical turbulence and improve dispersion of pollutants, as well as acting as a physical barrier to the transport of airborne pollutants.

While these power stations and other large industries are located outside of the Project site and emissions are released in a controlled fashion through stacks, it is recognised that these sources may still contribute emissions of pollutants to the regional airshed under certain meteorological conditions.

Given the above considerations, the potential impact is considered to be ***slight*** (i.e. the impact may be tolerated). Correspondingly, the impact significance should be considered to be ***intermediate/minor*** (refer to **Table 14**).

Table 14 Impact Significance – Other Surrounding Industries

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.3 Potential Impacts Associated with Existing and Future On-site Sources

9.3.1 Maldon-Dombarton Rail Line (MDRL)

The proposed Maldon-Dombarton Rail Line is approximately 35 km long. Construction work on the MDRL was started in 1983 but not completed as the project was abandoned. The recent MDRL pre-feasibility study found that much of the earthworks and completed components of bridge construction remain in place and in serviceable condition.

If the proposed MDRL project is approved, major construction activities will include site clean-up and restitution works, the construction of bridges and tunnels, and track-works. It is anticipated that the operation of the MDRL will comprise 24 hour freight operations, including coal trains, which will provide an alternative transport option the use of roads through the Illawara.

Studies in relation to the nuisance and health impacts of dust from coal wagon transport are currently ongoing. SLR has been involved in a number of studies (monitoring and dispersion modelling) of dust from loaded coal wagons which suggest that impacts reduce away from the rail centreline, but which also note that the distance at which dust reduces to 'background' levels is highly dependent on a number of factors including (but not limited to) the surface treatment of the coal wagons on departure from the coal loading facility, the distance from the loading facility, the speed at which the train travels and the cleanliness of the wagons themselves.

Given the above considerations, the potential air quality impact associated with the construction and the operation of the MDRL is considered to be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (refer to **Table 15**) and mitigation measures addressing ambient air quality and visual amenity should be implemented where possible. Mitigation measures are provided in **Section 11.3.1**.

It is noted that should a hospital be planned for location nearby the MDRL, the impact significance would be considered to be ***major/intermediate*** given a hospital is categorised as having a 'very high sensitivity' to changes in air quality.

Table 15 Impact Significance – Maldon-Dombarton Rail Line

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.3.2 Sydney-Moomba Gas Pipeline

Gas and ethane pipelines travel through the Project site travelling from the south end, across Picton Road and up to Bingara Gorge, and then eastwards to the existing town of Wilton. The easement is approximately 24 m wide and the pipes are steel and buried underground.

Natural gas is formed primarily of methane and can include ethane, propane ethane, propane, butane and pentane. Natural gas and ethane are odourless however the gas is odorised with merceptans for health and safety reasons (i.e. leak detection) hence significant odour emissions may be associated with rupture of the pipeline and/or emergency venting episodes as mercaptans give the natural gas a distinctive rotten egg smell.

It is understood that any future development application for a dwelling or a sensitive land use (i.e. school, aged care facilities, health care facilities and child care centres etc) on land within 750 m of the gas pipeline easement will require a risk assessment report to be prepared by a suitably qualified and experienced engineer. The risk assessment will make recommendations on measures to reduce the risk arising from a rupture of the pipeline or other gas leakage event. The gas pipeline therefore does not preclude future urban development within the investigation area but requires further detailed analysis and assessment for proposed development in proximity to the gas pipeline easement.

An initial risk assessment carried out by the APA Group concludes that the existing pipes will require additional thickness and encasing for urban purposes, and a suitable buffer area will be required for sensitive residential land uses. The Wilton Junction Master Plan has planned for open space areas to be provided along the gas pipeline easement. It may also be necessary to place a release valve within the site area. The VIC EPA recommends a separation distance of 250 m from natural gas wells and may be applicable to the placement of an additional emergency release valve on site.

Given the above considerations, the potential impact is considered to be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (refer to **Table 16**) and mitigation measures should be implemented where possible. Mitigation measures are provided in **Section 11.3.2**.

Table 16 Impact Significance – Gas Pipeline

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.4 Potential Impacts Associated with Construction Phase of the Development

During the construction phase, the potential for dust and other pollutants to be emitted from the development will be directly influenced by the nature of the activities being performed. Excavation and demolition works in particular are anticipated to potentially cause short-term emission of dust, which would require application of suitable dust control measures.

Additional sources of emissions to air during the construction phase will comprise exhaust emissions from trucks, plant and machinery, and fugitive emissions of VOCs through normal use and accidental spillage of fuels or other chemicals.

A temporary elevation in particulate emissions and local dust levels is considered to be inevitable as part of the construction works, particularly where those activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration. Unlike other pollutants, the presence and deposition of dust is dependent upon the distance from source to receptor and the prevailing meteorological conditions.

It is noted that construction activities are short term in nature and the majority of emission sources can be controlled at source through a range of available mitigation measures. Construction air quality impacts are assessed as being ***adverse*** in nature, ***short term*** (for the duration of the construction works) and ***reversible***.

It is noted that the draft Phase 1 Contamination Report prepared by Douglas Partners Pty Ltd (August 2013) concludes that the potential for significant contamination at the Project site is low. The following impact assessment therefore does not extend to earthworks occurring within contaminated soils. However, the report recommends that further detailed investigation should be undertaken to confirm the contamination status of the site prior to any development applications for subdivision or bulk earthworks. The emission of air pollutants during earthworks in contaminated soils has the potential to affect human health and generate nuisance odour. Appropriate remediation works and specific mitigation measures are therefore necessary to ensure that adverse air quality impacts are not realised. Refer to **Section 11.2** for potential mitigation measures.

9.4.1 Construction Works within 10 m of Sensitive Receptors

For sensitive receptors located within 10 m of construction site, the potential impact is considered to be ***substantial*** (i.e. the impact is predicted to cause significant consequences on the receiving environment). Correspondingly, the impact significance should be considered to be ***major/intermediate*** and specific mitigation measures should be adopted where applicable (refer to **Section 11.2**). Further more stringent mitigation measures and compliance monitoring should be implemented where contaminated soils are present.

It is noted that for construction works within 10 m of an operational hospital, the impact significance would be considered to be ***major*** and strict mitigation measures and compliance monitoring should be implemented.

Table 17 Impact Significance – Construction Works within 10 m of Sensitive Receptors

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.4.2 Construction Works within 1 km of Sensitive Receptors

For sensitive receptors located within 1 km of construction sites, the potential impact is considered to be ***slight*** (i.e. the impact may be tolerated). Correspondingly, the impact significance should be considered to be ***intermediate/minor***. Mitigation measures should be considered and adopted where applicable at all construction sites, particularly where activities are located along construction site boundaries facing residential areas and during adverse weather conditions. Potential mitigation measures are discussed in **Section 11.2**.

It is noted that where contamination is present in soils where earthworks are likely to take place, the impact significance should be considered ***major/intermediate*** and further more stringent mitigation measures and compliance monitoring should be implemented.

Where contaminated soils are present, the potential impact should be considered ***substantial*** and further more stringent mitigation measures and compliance monitoring should be implemented where contaminated soils are present.

Table 18 Impact Significance – Construction Works within 1 km of Sensitive Receptors

Sensitivity \ Magnitude	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5 Potential Impacts due to the Operational Phase of the Development

9.5.1 Traffic/Transport

The Canadian publication, "*Develop With Care 2012: Environmental Guidelines for Urban and Rural Land Development in BC* [British Colombia]: *Supporting Information – Air Quality*" (hereafter, BC Guidelines 2012) as prepared by the School of Population and Public Health at the University of British Columbia, provides general guidelines in relation to building placement and general land use for the purpose of reduced exposures and health risks associated with traffic proximity and air quality. The document also outlines the results of a recent comprehensive literature review of studies concerned with the spatial distribution of roadside pollutants.

The review demonstrates that monitoring undertaken for major roads with annual average daily traffic counts between 15,000 vehicles per day to 200,000 vehicles per day showed a major decrease in pollutant concentrations within the first 150 m to 200 m from the roadside (and most to local background levels). The 2008 Development Guidelines additionally states that pollutant concentrations can be expected to reduce by around 65% in the first 10 m from the road. The distance over which a reduction in concentration occurs varies according to the specific air pollutant, for example CO concentrations have been shown to decrease over the smallest distance from the road, while concentrations of particulates (as PM_{10}) and VOCs have been shown to decrease over the largest distance from the road.

In addition, high volume traffic intersections will emit higher pollutant concentrations than moving vehicles due to idling vehicles and stop-and-go traffic. The current road system does not utilise traffic signals at intersections however road upgrades are proposed to mitigate safety issues associated with future (2021) increases in traffic volumes associate with the Project.

Updated traffic volume data has been provided by Parsons Brinckerhoff (reviewed August 2013). Comparison of existing traffic volumes to the DP&E's 2008 Development Guidelines indicates that the Hume Highway and Picton Road may be classified as "busy roads". Project future traffic volumes for 2023, 2028 and 2036 scenarios shown that the percent increase in traffic between 2013 and 2023 to be the most significant. This is similar to the conclusions drawn from the Supplementary Traffic Review as discussed in **Section 6.3**.

Given current traffic volumes for the 2013 scenario, it is considered that the magnitude of vehicle-exhaust related emissions at sensitive receptors alongside the Hume Highway and Picton Road may be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (refer to **Table 19**) and mitigation measures should be implemented where possible.

Table 19 Impact Significance – Current Traffic Volumes (2013 Scenario)

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

Given the predicted traffic volumes for the 2023 scenario, it is considered that the magnitude of vehicle-exhaust related emissions at sensitive receptors may be ***substantial*** (i.e. the impact is predicted to cause significant consequences on the receiving environment). Correspondingly, the impact significance should be considered to be ***major/intermediate*** (refer to **Table 20**) and specific mitigation measures should be adopted where applicable. Potential mitigation measures are discussed in **Section 11.3**.

It is noted that should a hospital be planned for location nearby a public road, the impact significance would be considered to be ***major***.

Table 20 Impact Significance – Increased Traffic Volumes (2023 Scenario)

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5.2 Sewage Treatment

Bingara Gorge STP and Project Wastewater Treatment Plant

The current (or upgraded) STP and WWTP proposed for the Project will be located in the south-western corner of the Wilton Parkland site (refer to **Figure 4**). Nearest land uses (within the scope of this study) are currently planned to comprise of employment lands approximately 250 m to the south, enterprise and bulky goods areas approximately 300 m to the west, the town centre approximately 330 m to the west south-west and residential land uses approximately 250 m to the south-east. The Hume Highway is situated between the site and planned employment and enterprise land uses to the west which may act as an additional buffer to potential odour impacts.

It is noted that the odour dispersion modelling assessment performed for the Bingara Gorge STP predicted concentrations of odours at the 250 m buffer zone to be 0.5 OU (refer to **Section 3.10**) which meets the relevant criterion of 2.0 OU (see **Section 3.10.1**). Further odour dispersion modelling in subsequent design phases will need to take into account STP upgrades and the integration of a new WWTP to ultimately determine the actual buffer zone requirement for sensitive land uses planned nearby the STP/WWTP.

Based on the results of the original odour dispersion modelling completed for the Bingara Gorge STP and taking into account the proposed upgrade work and integration of a new WWTP, it is considered that the magnitude of odour emissions at nearby sensitive receptor locations (including planned employment and enterprise type land uses) may be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate***. Proposed mitigation measures should be adopted where applicable at the STP/WWTP and odour dispersion modelling should be undertaken during subsequent design phases (refer to **Table 21** below).

It is noted that should a hospital be planned for location nearby the STP/WWTP, the impact significance would be considered to be ***major/intermediate***.

Table 21 Impact Significance - Standard Operation of STP/WWTP

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

Sewage Pumping Stations (SPS)

Pumping stations are also proposed are part of the infrastructure to transfer sewage to the STP/WWTP. The current proposed locations of the SPS are shown in **Figure 4**. The location and design of SPS will consider wet well submersible designs for location within 100 m of an existing or proposed residential area and the distance of the proposed SPS from the closest residential boundary.

SPS usually consist of a small brick building, a wet well and may also include a small electrical substation and a vent stack. Odour should achieve 2 OU at the boundary of the SPS site to ensure suitable separation distances are provided between the proposed SPS and future sensitive receptor locations such as residences and schools. Previous odour impact assessments undertaken by SLR (using odour emission rates based on monitoring performed for relatively large SPS) have shown that compliance with relevant odour criterion of 2 OU at SPS boundaries is achievable.

Given all plant are proposed to be enclosed within buildings, it is considered that the magnitude of odour emissions at sensitive receptors may be ***slight*** (i.e. the predicted impact may be tolerated). Correspondingly, the impact significance should be considered to be ***intermediate/minor***. Mitigation measures should be adopted where applicable at all SPS sites (refer to **Table 22**). Further odour assessments may be required at the detailed design stage to allow the final locations, numbers of air vents and other odour control devices to be determined.

Table 22 Impact Significance – Standard Operation of SPS

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

Early Operations, Abnormal Operations and Maintenance Works

To completely eliminate odours would require sealed systems at all times however this may not be possible as:

- Regular maintenance requires covers to be removed.
- Sewage treatment involves a variable volume stream.
- Occasional operating failures can lead to short-term odour problems.

- Odours can be produced in pipes and pumping stations and escape through cracks, gaps and other unnecessary opening.

It is noted that the Sydney Water Corporation have found that odour complaints can be high in the early years of operation of a new wastewater system when flows are low and wastewater travel times are higher. During the first five years of the Picton Sewerage Scheme's operation (2000 to 2004) there were 20 odour complaints related to pumping stations while during the 2005 to 2009 period, there were no odour complaints from the reticulation system or plant (Sydney Water 2011). Staged planning of the Project should therefore take this information into consideration.

Given the above information, it is considered that the magnitude of odour emissions at sensitive receptors during early operations of the STP/WWTP and SPS may be ***substantial*** (i.e. the impact is predicted to cause significant consequences on the receiving environment). Correspondingly, the impact significance should be considered to be ***major/intermediate*** (refer to **Table 23**). Mitigation measures should be adopted where applicable at the STP/WWTP and all SPS sites (refer to **Section 6.4** and **Section 11.2**). Further odour assessments should be carried out at the detailed design stage to determine suitable buffer zones between wastewater infrastructure and sensitive land uses taking into account worst case odour emissions given an abnormal operations scenario.

It is noted that should a hospital be planned for location nearby the STP/WWTP, the impact significance would be considered to be ***major***.

Table 23 Impact Significance – Early Operation and Maintenance Works

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5.3 Lawn Mowing (Domestic/Commercial)

Lawn mowing represents a large area source of VOCs. All residential areas and commercial areas with lawns will utilise a mower on a regular basis. Emissions of VOCs, and products of the combustion of fuel such as NO_X, CO, SO_2, PM_{10} etc, will be generated during the use and storage of fuels and during use from mower exhausts. The amount of emissions generated will depend on the fuel quality, the type and age of the mower and its use. Fuel spillages during refilling activities and storage of fuels will also lead to evaporative emissions of VOCs.

Given the above considerations, it is considered that the magnitude of pollutant emissions due to future lawn mowing activities in the Wilton Junction Precinct may be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (refer to **Table 24**). Mitigation strategies should be considered for implementation in the Wilton area (refer to **Section 11.3**)

Table 24 Impact Significance – Domestic/Commercial Lawn Mowing

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5.4 Surface Coating (Domestic/Commercial)

The application of new surface coatings to buildings will generate evaporative emissions of VOCs over the short-term and will represent a large area source of VOCs during this time. Applications will continue with new development and overtime as surfaces age.

Given the short-term nature of this activity, it is considered that the magnitude of pollutant emissions due to future surface coating activities in the Wilton Junction Precinct may be ***slight*** (i.e. the impact may be tolerated). Correspondingly, the impact significance should be considered ***intermediate/minor*** (refer to **Table 25**). Mitigation strategies are provided for consideration in **Section 11.3**.

Table 25 Impact Significance – Surface Coating

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5.5 Use of Domestic Wood Heaters

Wood smoke from residential wood heaters is made up of a complex mixture of gases and particulate which can cause adverse health effects when inhaled. Wood smoke can consist of a large variety of chemical compounds including CO, NO_X and air toxics (i.e. benzene, formaldehyde, polycyclic aromatic hydrocarbons).

Air pollution due to wood heaters in winter months is of particular concern where inversion conditions are common (i.e. airbone pollutants are trapped under a cold air layer which lies over a warmer air layer) as this prevents dispersion of the plume and may pose a significant health risk due to increased exposure.

Given the above information, it is considered that the magnitude of pollutant emissions due to domestic household use may be ***moderate*** (i.e. the impact is predicted to possibly cause statutory objectives/standards to be exceeded). Correspondingly, the impact significance should be considered to be ***intermediate*** (refer to **Table 26**). Mitigation strategies should be considered for implementation in the Wilton area (refer to **Section 11.3**)

Table 26 Impact Significance – Domestic Wood Heaters

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

9.5.6 Light Industry

The potential emissions to air of some common activities (light industrial and commercial/retail) likely to form part of the development are described provided below, along with their respective VIC EPA recommended separation distances. Where no VIC EPA guidance exists for a specific activity, a precautionary and conservative separation distance of 100 m has been applied (for guidance only).

The listed activities should be considered on a case-by-case basis during the detailed DA phase to ensure local ambient air quality amenity can be maintained and best practice is employed where ever applicable with specific separation distances determined in consultation with the EPA.

The magnitude of the impact associated with these common industries has been determined assuming the recommended separation distances are complied with, however best practice and best available technologies (BAT) have not been adopted. Consideration has also been given to the potential local impacts on the Wilton airshed in terms of increased levels of particulate, and increased levels of NO_X and VOCs emitted to the atmosphere as precursors for ozone production given existing background levels of these pollutants (refer to **Section 8.1**).

An overview of best practice for these common industries is provided in **Table 28**. A reappraisal of the potential impact significance of these activities should BAT be adopted is provided in **Section 11.6.3**.

Table 27 Recommended Separation Distances and Impact Significance of Common Industries

Type of Activity	Potential for Emissions to Air	Recommended Buffer Distance from Sensitive Receptors (m)	Magnitude of the Impact	Impact Significance
Printing and Sign Manufacture	- The printing and coating industry uses a wide range of processes and materials (i.e. printing to film, paper and textile). Solvent-based ink systems have the potential to generate significant releases of VOCs into the atmosphere. - Sign manufacture processes (electroplating, anodising, acid etching and galvinising) are likely to generate emissions of metal dust, solvent emissions of VOCs (e.g. acetone, toluene, xylenes etc), acid mists, metal-ion bearing mists, metal and acid fumes. - Some amount of heat curing using an oven may also take place on site. It is likely that the associated air stream will be vented to the roof. Controls may be in place to reduce the concentration of substances in the vented air stream.	500 m is recommended for printers emitting >100 kilograms VOCs per day (see Section 4.6). Lesser buffer distances may otherwise apply, particularly where best practice can be demonstrated and suitable emission controls are implemented. Consult the EPA on a case by case basis.	Moderate	Intermediate
Automotive Repair	- Potential emissions to air from spray painting operations include evaporated solvent (as VOCs) and odours (caused by odorous solvents and VOCs). The volatile content of solvent-based paints can be greater than 50% and much of the solvent evaporates during baking or dry-off periods. - Solvents and thinners containing a high VOC content are also used to clean spray guns and other application equipment. - Some paint mixing is likely to occur on site. Fugitive VOC emissions due to spills and leaks may also escape through doors and windows. - Other emissions will include fuel emissions from standing cars (e.g. products of fuel combustion including emissions of VOCs, CO, NO_X and SO_2). - Dust emissions including metal dust will also be generated from maintenance activities and repairs. - Significant amounts of wastewater may also be generated and if poorly managed will result in nuisance odour impacts.	100 m is recommended however lesser buffer distances may apply where best practice can be demonstrated and suitable emission controls are implemented.	Moderate	Intermediate
Petrol Filling Station/ Truck Stop	- Emissions will include emission products of combustion from idling trucks and cars (e.g. diesel and petrol emissions of VOCs, CO, NO_X and SO_2). - Fuel storage, handling and transfer, accidental spillages and leaks may also generate fugitive emissions of VOCs. - VR1 and VR2 reciprocal feeds are becoming standard practice in Australia.	100 – 200 m is recommended for tanks exceeding 2,000 tonnes and floating roof or fixed roof respectively (see Section 4.6) Lesser buffer distances may apply where best practice and use of VR1 / VR2 systems can be demonstrated.	Moderate	Intermediate

Type of Activity	Potential for Emissions to Air	Recommended Buffer Distance from Sensitive Receptors (m)	Magnitude of the Impact	Impact Significance
Drycleaners	- Solvents used by the dry cleaning industry are likely to emit VOCs. - Most modern dry cleaners will use a closed loop process for maximum reduction of emissions to air. This process does not vent gas to the atmosphere and works to recycle (approximately 99%) of the solvent used continuously throughout the dry cleaning cycle. Assuming a closed loop system, the only air exchange with the atmosphere during dry cleaning operations will occur during machine loading and unloading operations. - Fugitive emissions of VOCs may occur from solvent spills or fugitive leaks. - Dust and lint is also likely to be generated on site. - Any wastewater treatment plant located within the building would also release emissions of VOCs, chlorinated hydrocarbons and potentially hydrogen sulphide. - Laundries may use a natural gas-fired boiler which will emit steam and gaseous emissions (NO_X, CO, hydrocarbons) during operation.	100 m is recommended however lesser buffer distances may apply where best practice can be demonstrated and suitable emission controls are implemented.	Slight	Intermediate/ Minor
Light Warehousing/ Workshops	- Packaging processes, forklift activities, trucks loading and unloading will generate dust and fuel emissions. - Nuisance emissions of dust and odour may be released through open window and roller doors. - Welding may be undertaken on these sites. Emissions from welding activities comprise of metal fumes (i.e. manganese, lead etc) and particulates. Gaseous pollutants are also generated during welding and include CO and NO_X.	N/A	Slight	Intermediate/ Minor
Food Outlets (cafes, takeaway, fast food)	- Nuisance odour may be generated due to cooking activities and the breakdown of natural fats and oils into odorous hydrocarbons and VOCs. - Particulate may also be emitted in the form of smoke and fumes due to roasting, barbecuing and grilling cooking processes. - Waste storage areas may also generate nuisance odours. - Good housekeeping measures and regular equipment maintenance scheduling can reduce overall emissions significantly. Most cooking fumes are extracted to the roof and released to the atmosphere through a stack. Air pollution control devices are generally implemented to further reduce emissions.	N/A	Slight	Intermediate/ Minor

10 REGIONAL MITIGATION STRATEGIES

10.1 Alternative Energy Use Considerations

Generating electricity from renewable energy sources such as wind and solar power, and reducing dependence on gas-fired power stations, would lead to improvements in air quality and visibility, and potentially offer significant public health benefits due to the reduced burning of fossil fuels.

The potential for renewable energy supply to the Wilton Junction Precinct should be considered and provided as an option for energy supply to residents and businesses residing in the Wilton local area.

10.2 Maldon-Dombarton Rail Line

Road freight is currently utilised for the transport of coal and other goods to Port Kembla for export. The MDRL would provide an alternative transport mode resulting in a decreased potential for road congestion, and improved air quality and greenhouse gas savings given rail freight is more significantly more fuel-efficient than road transport.

10.3 Background Air Quality Monitoring for Long-Term Mitigation

Background air quality monitoring for key pollutants (i.e. ozone, PM_{10} and NO_X) should be continued at locations representative of the Wilton local area to monitor changes in air quality over time. Monitoring will enable Project progress to be tracked against air quality goals and performance indicators, and allow future residences access to air quality information relevant to the Wilton local area.

The Bargo air quality monitoring station is closest monitoring station (see **Figure 5**) and is located approximately 11 km south-west of the Project site. It is noted that the topography between the proposed development site and Bargo monitoring station ranges from approximately 200 m AHD to 370 m AHD and this increase in topography could mean that decreased amounts of air pollution may be experienced in Bargo relative to the Wilton local area (refer to **Section 6.2**).

However, given the station's proximity to the site the Bargo monitoring site is considered most representative of air quality likely to be experienced at Wilton and is considered appropriate for background air quality monitoring purposes. Bargo air quality monitoring data should be compared to data measured at the Liverpool monitoring station to monitor changes in ozone over time. (The Macarthur air quality monitoring station has been decommissioned.)

11 LOCAL MITIGATION STRATEGIES

11.1 Complaints Handling

An effective complaints logging system should be maintained by Council (and the EPA) to monitor complaints and to effectively manage any requests for information or respond to any public concerns in relation to the proposed development activities throughout the construction and operational phases of the proposed Wilton Junction Precinct development.

11.2 Construction Phase

11.2.1 Nuisance Dust Control Measures

Ambient dust emissions from wheel-generated dust, excavation and rehabilitation, demolition, clearing and grading, truck loading and unloading, and wind erosion areas will be the primary focus of dust control during construction works at the Project site. Typically, emissions from these processes can be minimised through the implementation of water spraying, particularly during periods of heavy on-site activity.

Dust mitigation measures that may be implemented during the construction phase include:

- Silt and other material be removed from around erosion and sediment control structures to ensure deposits do not become a dust source.
- Amending of dust-generating construction activities during adverse wind conditions blowing in the direction of sensitive receptors. A wind sock should be made available and be visible to all areas of an active construction site to assist in reactive response procedures (i.e. to determine when construction activities should be postponed, minimised or relocated in windy conditions).
- Minimising the use of material stockpiles and locating them away from receptor locations.
- Reducing the truck speeds on site will reduce wheel generated dust.
- If dirt track out is causing problems, manual brushing of the truck's flanks and wheels could be implemented as a further precaution. Also, trucks exiting the site should be observed to determine if the both wheels travel over the shaker grid.
- Air emissions associated with all construction activities should also be managed through compliance with the Construction Environmental Management Plan (CEMP). The CEMP would be implemented so that:
  - The works are conducted in a manner that minimises the generation of air emissions.
  - The effectiveness of the controls being implemented is monitored.
  - Additional measures are implemented where required.
- A complaints management system is implemented so that any identified incidents or complaints are dealt with through investigation and implementation of corrective treatments.
- Construction contractors should also undertake daily environmental inspections of their works and worksite. The daily environmental inspection reports should include the below observations, with remedial or corrective actions noted (as appropriate).

  Any remedial or corrective actions should be reported to the Site Manager as soon as is practicable. Inspections may include, but not be limited to:
  - Visual inspection of dust generation.
  - Ensure roads leaving the site are free of soil, and prevention of soil tracking onto the road network.
  - Inspection of the erosion and sediment controls.
  - Inspection of the waste storage areas.
  - Inspection of any rehabilitated areas (where relevant).
  - Ensure all hazardous goods, including fuel and oil, are adequately stored or bunded.
  - Ensure spill kits are appropriately located and stocked.
- Ambient air quality monitoring may be required where sensitive receptor locations are located proximal to construction activities (i.e. real-time PM_{10} monitoring or dust deposition monitoring).

- Compliance air quality monitoring will likely be required where hospitals or medical centres are located proximal to construction activities (i.e. real-time PM_{10} monitoring including alarms).

11.2.2 Plant and Machinery

Control measures relating to plant and machinery that may be implemented during the construction phase include:

- Ensuring vehicles and machinery are maintained in accordance with manufacturer's specifications.
- Minimising truck queuing and unnecessary trips through logistical planning of materials delivery and work practices.
- Stationary trucks should switch off engines if idling time on-site is likely to exceed 2 minutes and should avoid using the local road network during peak traffic periods.
- Fixed plant should be located as far from local receptors as practicable.

11.2.3 Fuel Storage Areas

The storage of fuels will be performed in accordance with the relevant Australian Standards. The Australian Institute of Petroleum's document, *Guidance for the Safe Above Ground Fuel Storage on Farms and Industrial Sites* (AIP GL12-2003), provides a succinct summary of the above requirements and a checklist to appraise whether the fuel storage facility is deigned and operated in compliance with the relevant Australian Standards. The Australian Capital Territory (ACT) Government has also produced a guidance document entitled *Environmental guidelines for service station sites and hydrocarbon storage* (2011), which provides further clarification and advice concerning environmental monitoring around fuel storage facilities.

Control measures that may be implemented during the construction phase will be referenced from the above AS, and will:

- Locate fuel storage and handling areas as far from local receptors as practicable.
- Storage areas for all liquids should be appropriately bunded.
- Spill kits including absorbing materials should be provided nearby handling and storage areas.
- Where possible, the delivery of liquid fuels should utilise reciprocal feeds, so that tank vapours are displaced into the delivery vehicle rather than being emitted to the atmosphere as a fugitive emission.
- Empty containers should be managed and disposed of in appropriate manner.

11.2.4 Contaminated Soils

Where there is the potential for invasive ground works to cause the emission of odorous ground vapour or contaminated dust particles, these impacts would be specifically addressed in the CEMP, and an odour assessment and management procedure developed to manage the risks of off-site odour impacts and/or health impacts from the volatilisation of ground contaminants.

General odour mitigation measures and controls that may be implemented during the construction phase include:

- Restricting ground invasive works to the hours of 7am and 6pm, Monday to Friday, and between the hours of 8am and 1pm on Saturdays.
- Keeping excavation surfaces moist.
- Using appropriate covering techniques to cover excavation faces or stockpiles.
- Use of soil vapour extraction systems and regular monitoring of discharges.

11.3 Operational Phase Mitigation Strategies

11.3.1 Maldon-Dombarton Rail Line

To reduce the potential for amenity impacts from rail freight operations, and particularly coal freight, the use of setback and vegetative screens is recommended. Vegetative screens will help to reduce visibility and will act as a physical barrier to the potential transport of air pollutants in the direction of sensitive receptors This will be particularly important where prevailing wind directions have the potential to transport dust from the rail line in the direction of sensitive land uses.

A good vegetative buffer should be comprised of at least three rows of a diverse variety and height of plants. As a guide, the width of the buffer should be at least 10 m wide (wider if possible depending on site constraints). The height of plants chosen should range from shrub height to higher than that of a loaded coal train. Vegetative screens should also aim to provide and maintain a permeable barrier which allows sufficient air movement through trees and other plants. A porosity of 50% is acceptable (i.e. approximately 50% of the buffer should be air space).

Plants chosen should include primarily native and evergreen species with long, thin rough foliage as well as rough bark as these factors will be most effective for physical entrapment of airborne pollutants. The selection of suitable species should involve liaison with experienced locals, farmers and nurseries to ensure the plants chosen do not compete with adjacent crops (where applicable). The design of the buffer should take into account rail maintenance and bushfire control requirements (i.e. weed control and access). Plants can take at least 5 years to be effective if not planting older stock so early planning is required to ensure the buffer is effective once rail lines become operational nearby to residential land uses.

Rail operators will be responsible for the cleanliness of coal wagons. The use of covers for coal wagons should be considered.

11.3.2 Sydney-Moomba Gas Pipeline

Suitable separation distances should be provided between sensitive land uses, the gas pipeline and release valves. A precautionary buffer distance of 250 m may apply unless further assessment or consultation with the EPA determines that a lesser buffer distance is appropriate. The gas pipeline should be appropriately protected to decrease the risk of pipeline rupture and to ensure accidental damage does not occur. Appropriate signage should also be provided.

11.3.3 Traffic/Transportation Impacts

As discussed in **Section 6.3**, a supplementary traffic review concluded that significant traffic increases along the Hume Highway and Picton Road by 2023 would result in existing priority controlled intersections reaching capacity before 2023 and that road upgrades would be required to provide alternative intersection controls (i.e. traffic signals or roundabouts) to address associated road safety issues.

As documented in the BC Guidelines 2012, a review of air quality monitoring studies on traffic air quality impacts has shown that high volume traffic intersections will emit higher pollutant concentrations than moving vehicles due to idling vehicles and stop-and-go traffic, while motor vehicles will emit fewer pollutants at steady speeds or in freely flowing conditions. A wide range of factors including vehicle type and condition, fuel quality, weather conditions and traffic flow, will also influence the level of pollution at the roadside.

Master Plan Design Phase Measures

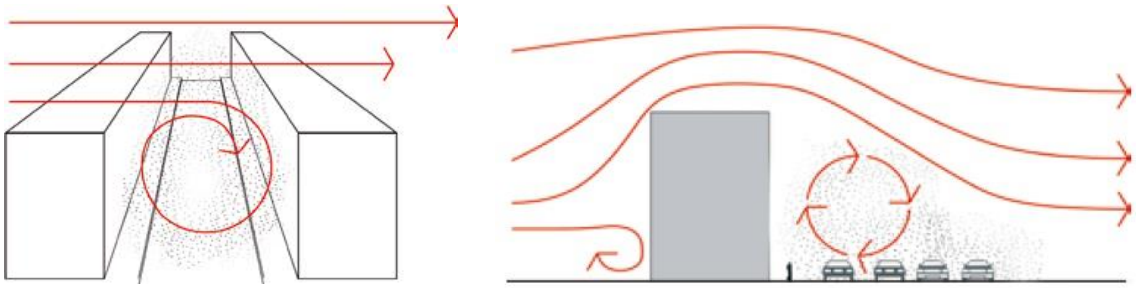
The following mitigation strategies should be considered at the design phase where feasible and practicable (i.e. not at the expense of road user safety and taking into consideration the available interchange footprint) to increase the potential for free flowing traffic in place of stop-and-go traffic:

- Use of slip roads and merge lanes for traffic turning left off the Hume Highway in place of traffic signals.
- Use of slip roads and merge lanes for traffic turning right or left onto the Hume Highway in place of traffic signals.
- Use of roundabouts where applicable in place of traffic signals.
- Use of bridges in place of traffic signals at intersections.

- Location of sensitive receptors away from busy roads (i.e. the Hume Highway and Picton Road).

Additionally, it is recognised in the 2008 Development Guidelines that areas which are not confined tend to have greater winds and breezes and aid in the dispersion of pollutants. The degree to which winds and breezes carry away air pollutants will be influenced by the orientation and continuity of spaces, their dimension and shape, topography and the layout of building surrounding the subject area. For example, buildings placed on either side of a busy road ('busy road' as defined in **Section 4.5**) can create roadway canyons (refer to **Figure 20** below).

Figure 20 Roadway Canyoning and Building Wake Effects



Source: Development Near Rail Corridors and Busy Roads – Interim Guidelines (Department of Planning, 2008)

Site planning is therefore an important consideration for new development planned nearby busy roads.

Mitigation strategies to be considered during the design and detailed DA phases of the works are recommended to include the following:

- Stepping back the upper storeys of roadside buildings and having buildings of different heights interspersed to increase the dispersion of air pollutants and minimise the canyoning effect of tall buildings close to the road.
- A setback provision of at least 10 m from the road for all new developments.
- Provision of mechanical ventilation (i.e. air conditioning) for sensitive land uses planned alongside busy roads in compliance with the requirements of the BCA.
- Natural ventilation options creating cross flow through indoor spaces (i.e. windows located strategically to allow wind flow through an apartment).
- Sensitive uses within buildings (such as living areas, outdoor spaces and bedrooms) located as far as practicable from busy roads.
- Use of vegetative screens (i.e. linear rows of shrubs and/or trees) or other barriers (designed with 50% porosity) where possible within the 10 m setback provision between busy roads and roadside buildings to assist in local ambient air amenity.

The Wilton Junction Master Plan objectives for the development will also provide specific transport initiatives to the Wilton development for reduction of external traffic generation, including specifically:

- Co-location of land uses to reduce travel.
- Provision of internal cycle and pedestrian links, including provision of suitable and sufficient bike storage facilities.
- Provision of internal public transport services (buses).
- Provision of public transport services (buses) external to the Project site (i.e. to Picton, Wollongong and Campbelltown).
- Development of green travel plans.
- Strong connectivity links between suburbs within Wilton.
- Provision of work from home initiatives (i.e. high speed internet connections) to help achieve a 50% containment of traffic within the Wilton area.

It is recommended that a consultative approach is undertaken during the design phase of the Project to assist in the development of a local Bike Plan which includes input from bicycle groups in Sydney. As a minimum requirement, bike paths should provide direct cycleways between points of interest (i.e. town centres, schools and commercial/retail areas) applying a similar logic to the planning of roads and railways and kept separate to pedestrian pathways.

Further general initiatives of the Wilton Junction Master Plan which will influence the reduction of external traffic generation include:

- Integrating and co-locating employment activities with the proposed town centre.
- Providing a range of housing types and choice to facilitate affordability.
- Provision of community services with a focus on quality and accessibility of facilities.
- Creating a strong sense of identify and a cohesive community.
- Creating focal points for neighbourhoods.

Detailed DA Stage Measures and Council Considerations

Additional mitigation strategies that should be considered during the detailed DA phase and for implementation by Council for the Wilton Junction Precinct include:

- Utilisation of hire car initiatives (such as 'goget', 'Car Next Door', 'Drive My Car Rentals') for internal residences.
- Implementation of a Bike Plan for the Wilton area (and surrounding areas).
- Provision of sufficient bike hire and maintenance stores around township areas.
- Businesses should be encouraged to development Sustainable Travel Incentive Schemes which encourage and reward employees commuting to work using sustainable travel modes (i.e. walking, cycling, public transport, car-share). Council may also initiate a fun competition between businesses providing such incentives.
- Council may consider providing discounted parking rates for people who car share.
- Council may also consider providing disincentives for driving to work including paid parking requirements and limited parking.
- Provision of additional internal and external bus connections.

11.3.4 Early/Abnormal Operation and Maintenance Works - STP/ WWTP and SPS

Master Plan Design Phase Measures

Careful planning of sensitive land uses to be located nearby the STP/WWTP and SPS should be undertaken where appropriate to decrease risks associated with nuisance odour impacts during the early operations.

Mitigation measures currently proposed for the STP/WWTP and SPS have been detailed in **Section 6.4** and are outlined below:

- Inlet works will be enclosed and air to be extracted and treated by odour control device prior to release to atmosphere.
- Screenings and grit bins will be housed within an enclosed building and the air extracted to an odour control device. Doors are to remain closed except during removal and replacement of bins.
- Biosolids holding tanks will generate odours during storage and so the headspaces of the tanks will be connected to odour control devices.
- Biosolids pumping and transfer may generate release of odour from road tankers. During pumping the inspection hatches will be connected to an odour control device via a hose. The connection will allow for displaced vapours from tankers to be placed back to the storage tank headspace, where they would be captured and treated by an odour control device.
- The odour control system will comprise an organic media biofilter which are able to achieve high efficiency removals of odorous compounds including hydrogen sulphide and VOCs.

For each SPS, mitigation measures include sealing of the wet well cover and sealing of concrete channel housing electrical cables to pump house (which will effectively mean that there will be no odour emissions from the pump house).

Furthermore, the DP&E's document "NSW Best Practice Odour Guideline" (Draft 2010) states that SPS should be operated according to best practice including:

- Designing pump stations for either the ultimate population catchment size, or a specific long-term time horizon.
- Designing pump stations to ensure that the sulphide generation potential achieves the 2 OU odour assessment criteria at the boundary of the facility.
- Adopting new technology that overcomes specific odour problems as the technology becomes available.

Applying best practice odour management measures also ensures the latest Australian Standards are adopted for the design of a new sewerage system.

For SPS, odour management is largely related to control of septicity and the provision of ventilation. The prevention off septicity of sewage or sludge requires inhibition of the micro-organisms responsible or measures to prevent anaerobic conditions from developing. Septicity is most serious down-stream from a rising-main sewer and during summer months, when temperatures are high. In most circumstances, total prevention of septicity would not be practical or economical. Hence, containment to avoid creating an odour nuisance is normally the most effective strategy.

Odour problems (and associated corrosion due to sulphides) can be minimised by:

- Oxidation of hydrogen sulphide before it can be emitted to the atmosphere.
- Conversion of hydrogen sulphide to hydrogen sulphide ions and disulphide ions by addition of alkali.
- Avoiding turbulent conditions to avoid excessive loss to the atmosphere.
- Scrubbing of vented gases (including air) to remove malodours.
- Avoiding excessive accumulation of debris and grit in pipes and tanks.
- Avoiding unnecessary contact of sewage and sludge with the atmosphere.
- Minimising retention under anaerobic conditions.

Prevention of septicity in sewage and sludges is possible by the use of chemicals, including:

- Injection of oxygen can be used to maintain aerobic conditions in rising-main sewers.
- Addition of nitrate to provide an alternative source of energy for respiration is used widely to keep sewage and sludges anoxic.
- Addition of oxidant chemicals, such as hypochlorite, hydrogen peroxide and potassium permanganate is used to reduce microbial activity and oxidise previously formed sulphides.
- Iron salts added to sewage or sludge will react with sulphides to form insoluble iron sulphide and will catalyse the rate of oxidation of sulphide. Addition of alkali may be unsuccessful at preventing odour nuisance as it would result in the formation of alkaline odours.

Additionally, the installation of appropriate buffers (i.e. vegetated) between residences and SPS should also be considered for local ambient air quality and visual amenity benefits.

Detailed DA Stage Measures

Further odour dispersion modelling will be undertaken prior to subsequent design phases on the STP/WWTP to determine actual buffer zone requirements between the treatment plant (or future plant and other any other associated infrastructure that may potentially generate odour) and sensitive land uses.

Odour dispersion modelling should allow for abnormal operation of the STP/WWTP and should include predictions of odour at the most exposed existing or likely future off-site sensitive receptor (i.e. residence or office) at which compliance will be assessed. It is anticipated that odour control will need to be implemented at the treatment plant including that odour generating sources enclosed or covered to minimise fugitive emission from odorous areas, with air extracted, treated and discharged in a controlled manner via a stack.

Future Measures

Residences located nearby maintenance works to the sewerage system should be notified sufficiently prior to any works being undertaken to allow these residences to limit their exposure to nuisance odour by closing windows or planning to vacate the premises during planned maintenance works.

11.3.5 Lawn Mowing

Detailed DA Stage Measures and Council Considerations

A future mitigation strategy to be considered by Council and at the detailed DA stage, particularly for commercial activities, should include such potential measures as the reduction of lawn area at the premises through careful garden design and the active encouragement of Wilton residences to trade in old lawn mowers for cordless electric mowers or even manual mowers (improved designs have made manual lawn mowers much easier to push than they use to be) for small to medium sized lawns (i.e. through the provision of a discount on the purchase of a more efficient mower or through a similar incentive scheme).

Businesses should also be encouraged to use electric ride-on mowers (and electric leaf blowers). Recreational and open space areas should also be maintained taking cleaner alternatives into consideration. Slow growing lawns and planting of non-deciduous trees may also be recommended at the detailed design phase to reduce the requirement and frequency for lawn mowing.

11.3.6 Surface Coating

Detailed DA Stage Measures

Mitigation strategies to consider during the application of new surface coatings should include:

- Use of low-VOC paints and solvents where feasible and practicable.
- Fuel/oil/solvent/chemical storage areas appropriately bunded in compliance with BCA requirements (refer to **Section 4.4**) and spill kits located proximal to storage areas as well as high use areas for immediate clean-up of spills and leaks for mitigation of fugitive release of VOCs.

11.3.7 Wood Heaters

It is anticipated that wood heaters will be uncommon to the urban area of Wilton Junction and that gas heating will likely be adopted as the standard method of domestic heating. The following section provides a summary of recent air quality policy advances associated with the use of wood heaters and measures that may be undertaken to phase out old wood heaters in the Wilton area.

Consultation Regulation Impact Statement

As part of the National Plan for Clean Air, the Council of Australian Governments (COAG) Standing Council on Environment and Water (COAG Council) have released a consultation *Regulation Impact Statement* for reducing emissions from wood heaters for public consultation. The consultation *Regulation Impact Statement* assesses alternative policy options that could be employed to reduce emissions from wood heaters in Australia, and establishes their relative costs and benefits.

Measures proposed include:

- Wood heater design and performance standards.
- Measures to promote compliance of retail modes against these standards.
- Measures influencing in-service operational performance of wood heaters (i.e. education, incentives to replace old heaters, common definition of excessive smoke to enhance enforcement action, regulatory controls on modification and installation of heaters, controls on second hand heaters, removal of non-compliant heaters and bans on the installation of heaters in certain areas.)

It is noted that the NSW and Tasmanian regulations define ‘excessive smoke’ as smoke which is visible 10 m or more from the chimney for at least 30 seconds at a time, as well as being generally visible for at least 10 minutes.

Feedback on past programs indicates that general information provided community-wide needs to be supplemented with highly targeted measures tailored for each airshed/community and:

- Aim to improve wood heater operation using a wide range of media.
- Directly engage with households whose heaters produce excessive wood smoke.
- Build on past education programs and integrate with current education programs conducted in each airshed.
- Inform the community about complementary provisions or other programs.

Two key measures are typically used to characterise the performance of wood heaters: the wood heater's operating efficiency and the wood heater's particle emission level.

Current Australian Standards that cover wood heater emissions and efficiency (i.e. AS/NZS 4012 and AS/NZS 4013) cover a standard test method (including fuel loading, operating procedures and sampling methods) and an emission criterion of 4 grams of particulate matter (as PM_{10}) emitted per kilogram of fuel burnt (4g/kg). There is currently no efficiency criterion, but there is a requirement that the efficiency result be reported (along with other information) on a label permanently attached to the appliance.

Current Practice

No jurisdiction currently requires wood heaters to meet a minimum efficiency standard, although there is a requirement under AS/NZS4013 (1999) for the test efficiency to be shown on each heater's certification label.

Some jurisdictions have extra measures to curb particle emissions from in-service wood heaters, which for example, incentives for the replacement of old wood heaters, and education programs and regulations applicable to the resale of second-hand wood heaters.

Bans on the installation of wood heaters in designated urban areas have been implemented overseas. Examples include Montreal, Dublin and regions in New Zealand. In Australia, a number of local government bodies have called on state governments to consider state-wide bans or limitations on the installation of wood heaters. In NSW wood heaters cannot be installed without the approval of the local council under the *Local Government Act 1993*. Local government planning instruments have been used to ban the installation of wood heaters in several new release areas in NSW by Camden and The Hills Shire Councils.

Detailed DA Stage Measures and Council Considerations

With consideration to the above information, it is proposed that wood heater standards (including efficiency rating standards and cleaning provisions) are implemented during the detailed DA stage for all new development in consultation with the EPA.

The installation of a new wood heater should consider accurate sizing for heating space requirements. Best practice also requires that the flue and the fan are cleaned once per year, and the baffle plate should be checked to ensure it is in good condition and in position.

Where gas is available, sealed gas log fires should be considered over open gas log fires for higher efficiency and better space heating.

At the very minimum, wood heaters should comply with the Australian Standards listed above.

Areas of concern to the DA process should include designs involving poor installation, installation of heaters that do not comply with AS, and modification of wood heaters.

Eco-sustainable development principles should also be considered during the detailed DA stage as they relate to heating requirements ensuring appropriate insulation of housing/buildings and north facing designs where applicable.

A ban on wood heaters should be considered where appropriate. Consultation with the EPA and Council should be undertaken to determine if a ban on wood heaters is appropriate for the Wilton area.

11.4 Overview of Best Practice and BAT for Light Industry

The potential for atmospheric emissions from common industries and the predicted impact on surrounding sensitive receptors (as highlighted in **Section 9**) are anticipated to be largely controllable through a range of mitigation measures including good site management, good housekeeping measures, vehicle maintenance and applying appropriate air quality control measures and devices where applicable.

A review of best practice for common industries assessed in **Section 9.5.3** is provided in **Table 28** and should be considered for implementation as part of the DA process of the development works.

Detailed DA Stage Measures

General best practice measures for all industries considered for the development will include:

- Compliance with relevant Australian Standards and BCA requirements.
- Use of low-VOC materials and solvents where feasible and practicable.
- Implementation of appropriate air extraction systems for equipment/activities generating significant air pollutant emissions, and implementation of suitable air pollution control (APC) devices and stacks to ensure compliance with POEO Act limits and regulations (refer to **Section 4.1**).
- Fuel/oil/solvent/chemical storage areas appropriately bunded in compliance with BCA requirements (refer to **Section 4.4**) and spill kits located proximal to storage areas as well as high use areas for immediate clean-up of spills and leaks for mitigation of fugitive release of VOCs.
- Regular inspection, maintenance and cleaning of equipment, extraction systems, ductwork, and APC devices, exhaust fans etc as required and in accordance with manufacturer's specifications.
- Appropriate operation of all equipment in accordance with manufacturer's specifications.
- Regular visual inspection of stacks and odour 'sniff tests' at site boundary during peak operations, start-up and shutdown.
- Implementation of good housekeeping practices and standard operating procedures addressing clean up and appropriate disposal of waste materials and old containers/drums.
- Provision of a concise Environmental Management Plan outlining operating procedures, internal checking protocols, staff training requirements and awareness of air quality control measures and other environmental initiatives and commitments.
- Maintenance of a complaints log including all relevant details of the complaint / complainant.
- Provision of an adequate separation distance (e.g. 100 m) to reduce land use conflicts where best practice is not achieved.

Table 28 Best Practice Measures for Common Industries

Type of Activity	Potential for Emissions to Air
Printing and Sign Manufacture	- Where a heat curing oven is used, associated air stream to be captured and directed to an appropriate rooftop stack. - Extracted air should be passed through an efficient filter or wet scrubber to remove the bulk of the entrained paint particles. - Use of equipment vacuum systems where applicable to significantly reduce the generation of nuisance dust and particulate during surface preparation activities. - Use of low-VOC paints where feasible.
Automotive Repair	- Where spray painting is undertaken, use of a spray booth complaint with Australian Standards. - Where the spray booth is used more or less continuously, extracted air should be passed through an efficient filter or wet scrubber to remove the bulk of the entrained paint particles. - An efficient wet collection device may be required incorporating a wet filter spray chamber containing enough spray nozzles and with enough water circulation to remove entrained paint particles. Note: A water curtain is useful only to maintain booth cleanliness and is not acceptable as a collection device. - If spray painting is carried out only a few times a week, an air extraction system may be adequate to dilute solvent fumes. - Stationary vehicles to switch off engines if idling time on-site is likely to exceed 2 minutes. Post signs communicating this requirement to drivers. - Engine maintenance performed indoors where possible and a suitable air extraction system provided for compliance with occupational health and safety (OH&S) requirements. - Use of dustless sanding vacuum system which will significantly reduce the generation of nuisance dust and particulate during surface preparation activities. - Use of high-solid paints to reduce the amount of paint used per car. - Use of a wastewater collection system included bunded workshop. Water run-off may be drained into a

Type of Activity	Potential for Emissions to Air
	Triple Interceptor pit which will separate water and solids for licenced contractor removal. Potentially odorous air to be captured and treated prior to release to air.
Petrol Filling Station/Truck Stop	- Minimise truck queuing through appropriate planning of truck stops and petrol filling stations. - Stationary trucks/vehicles to switch off engines if idling time on-site is likely to exceed 2 minutes. Post signs communicating this requirement to drivers. - Stage 1 vapour recovery (VR1) captures VOC emissions that are vented from underground storage tanks as they are filled by road tankers. VR1 is currently fitter at most service stations in the Sydney region and should be fitted for any such station planned for the Wilton Junction Precinct. - Reciprocal feeds (i.e. Stage 2 vapour recovery [VR2]) are becoming standard practice in Australia and should be implemented for small and large service stations. VR2 captures and recycles up to 95% of VOCs at service stations. - Provision of suitable waste receptacles on site.
Drycleaners	- Use of a closed loop process for maximum reduction of emissions to air. This process does not vent gas to the atmosphere and works to recycle (approximately 99%) of the solvent used continuously throughout the dry cleaning cycle. - Use of a closed loop boiler system. Resultant emissions to be captured and treated prior to release to atmosphere via an appropriate rooftop stack. - Enclosed building and suitable air extraction provided for compliance with OH&S requirements. - The system for each drycleaning unit should be capable of containing a leak, spill or release of drycleaning solvent up to a quantity equal to 110% of the total amount of solvent that may be stored in the largest tank within the containment area. - Potentially odorous air from wastewater treatment areas (where applicable) to be captured and treated prior to release to air. - Delivery vans and other vehicles to switch off engines if idling time on-site is likely to exceed 2 minutes. Post signs communicating this requirement to visitors to the site. - Delivery of drycleaning solvents should be adequately monitored to prevent overfills and spills. Dense non-aqueous solvents or other products delivered to drycleaning facilities via closed, direct-coupled delivery systems.
Food Retail (cafes, takeaway, fast food)	- Enclose raw material during handling and processing activities, and refrigerate. - Capture cooking fumes at source through use of an extraction canopy or kitchen hood located above cooking and dishwasher areas. The plan dimensions and the height of this equipment are important. A grease filter is typically used which comprise of layers of galvanised or stainless steel mesh with a steel housing. - The plan dimensions should exceed those of the catering equipment, with overhand at the front provided to cope with steam or fumes. - The height of the canopy should ideally be located between 450 mm and 1,350 mm from the top of the cooking surface to the lowest edge of the grease filter. - Use of stainless steel for canopies is best practice. - Extraction fans need to be sized to cope with design pressure. - Air pollution control devices may be implemented to further reduce emissions. - Remove oil and grease by filtration of other means. - Regular cleaning of kitchen hoods, ductwork, filters, grease traps for odour control. 3 monthly cleaning intervals are recommended for heavy use kitchens operating between 12 to 16 hours per day. - Enclose waste and waste storage areas and remove wastes promptly from the premises. - Delivery vans and other vehicles to switch off engines if idling time on-site is likely to exceed 2 minutes. Post signs communicating this requirement to visitors to the site.
Light Warehousing/ Workshops	- Location of stationery plant (i.e. generators) away from sensitive receptors and indoor if possible with a suitable air extraction system. - Trucks/vehicles to switch off engines if idling time on-site is likely to exceed 2 minutes. Post signs communicating this requirement to visitors to the site. - Fumes from welding captured via welding booths, hoods, torch fume extractors and flexible ducts, and airborne contaminants mitigated by directing captured air through high efficiency filters, electrostatic precipitators, particulate scrubbers and/or activated carbon filters.

11.5 Environmental Standards and Partnerships for Development

11.5.1 Master Plan Design Phase Measures

The proposed development should consider the objectives and actions of the *Action for Air* plan wherever relevant.

11.5.2 Detailed DA Stage Measures and Council Considerations

Businesses to be located in the Wilton Junction Precinct should be actively encouraged to form partnerships or volunteer for relevant programs established under the *Action for Air* plan (i.e. Sustainability Advantage, Green Business Program etc) and/or those established through other government/organisational initiatives (i.e. NABERS and Green Star).

National standards (i.e. BCA, Australian Standards, BASIX) should be complied with and voluntary programs (such as NatHERs and Green Star) should be incorporated into conditions of consent where appropriate for residential developments. Organisations providing infrastructure to the Project site should consider partnership with the suitable programs (such as the AGIC IS rating scheme particularly in relation to the emissions to air category).

11.6 Key Performance Indicators

Key performance indicators (KPIs) should be established to monitor progress against ambient air quality and amenity targets. Information relating to key mitigation strategies could be collated by Council through DA submissions, targeted community surveys, census results, consultation with relevant community groups, and review of relevant compliant logging systems. Proposed KPIs may be based on the following:

11.6.1 Construction Phase

- The frequency and nature of complaints received each year in relation to nuisance dust/odour.
- Compliance with air quality standards, the CEMP and air quality control measures, as indicated by associated reporting requirements.
- Contractor and employee awareness of the CEMP and air quality control measures and goals.

11.6.2 Operational Phase

- Retention rates achieved per year of people living in Wilton that work from home or work within the Wilton local area.
- The percentage of businesses involved in voluntary partnerships, having documented Environmental Management Plans and/or implement effective environmental awareness programs such as sustainable travel initiatives.
- The level of utilisation of community bike facilities (i.e. bike storage racks during work hours).
- The frequency and nature of complaints received in relation to public transport services.
- The percentage of electric lawn mowers and gas heaters used in the Wilton local area.
- The frequency and nature of complaints received in relation to nuisance dust/odour in the first five years of established light industry and STP/WWTP and SPS operations.
- Compliance with air quality goals and standards, and air quality control measures.
- The level of feedback received from the community, including positive feedback.

11.6.3 Reappraisal of Potential Impacts on Sensitive Receptors

A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors (see **Section 9.4** and **Section 9.5**) has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies. These are termed “residual impacts”. Only future activities associated with the development have been reassessed.

Table 29 Impact Significance Reappraisal for Mitigated Development Activities

Activity Category	Predicted Unmitigated Impact		Proposed Mitigation	Predicted Residual Impact	
	magnitude	impact significance		magnitude	impact significance
Construction Phase					
Within 10 m of sensitive receptors	substantial	major/intermediate	See Section 11.2	moderate	intermediate
Within 1 km of sensitive receptors	slight	intermediate/minor	See Section 11.2	negligible	neutral
Operational Phase					
24 hour MDRL operation	moderate	intermediate	See Section 11.3.1	slight	intermediate/minor
Sydney-Moomba gas pipeline	moderate	intermediate	See Section 11.3.2	slight	intermediate/minor
Traffic/Transport (2013 scenario)	moderate	intermediate	See Section 11.3.1	slight	intermediate/minor
Traffic/Transport (2023 scenario)	substantial	major/intermediate	See Section 11.3.1	moderate	intermediate
STP/ WWTP peak operations	moderate	intermediate	See Section 11.3.4	slight	intermediate/minor
SPS peak operations	slight	intermediate/minor	See Section 11.3.4	negligible	neutral
STP/ WWTP & SPS early operations	substantial	major/intermediate	See Section 11.3.4	moderate	Intermediate
Lawn mowing (domestic/commercial)	moderate	intermediate	See Section 11.3.5	slight	intermediate/minor
Surface coating (domestic/commercial)	slight	intermediate/minor	See Section 11.3.6	negligible	neutral
Domestic wood heaters	moderate	intermediate	See Section 11.3.6	slight	Intermediate/minor
Light Industry & Commercial/Retail					
Printing and sign manufacture	moderate	intermediate	See Section 11.4	slight	intermediate/minor
Automobile repair	moderate	intermediate	See Section 11.4	slight	intermediate/minor
Petrol filling station	moderate	intermediate	See Section 11.4	slight	intermediate/minor
Drycleaners	slight	intermediate/minor	See Section 11.4	negligible	neutral
Light warehousing/workshops	slight	intermediate/minor	See Section 11.4	negligible	neutral
Food outlets	slight	intermediate/minor	See Section 11.4	negligible	neutral

12 CONCLUSION

SLR Consulting Australia Pty Ltd has been commissioned by Elton Consulting, on behalf of the Wilton Junction Landowners' Group, to undertake a high level Air Quality Opportunities and Constraints Assessment for the proposed Wilton Junction Precinct (the Project).

The scope of this study has been limited to a high level risk-based (qualitative) assessment the purpose of which is to identify potential opportunities and constraints associated with the development with respect to air quality, and identify any constraints from existing and proposed sources of emissions to air from local industry and commerce proximate to the subject land.

The table below demonstrates the Project's compliance with the Director-General's Requirements.

Compliance Table

Director-General's Requirements	Report Section
Undertake an assessment for the Wilton Junction Precinct that includes recommended strategies that will be implemented to improve or maintain air quality to ensure National Environmental Protection Measures for ambient air quality are not compromised, in consultation with the Environment Protection Authority (EPA).	Section 1.1, Section 9
Identify strategies at a local level to ensure air emissions do not cause adverse impact upon human health, the environment and community amenity.	Section 11

It has been determined that the existing and proposed surrounding industries will not form a significant constraint on the development in terms of air quality, where suitable mitigation strategies are implemented.

Key issues identified for the construction and operational phases of the Project are provided in the table below along with corresponding mitigation strategies proposed for maintenance of ambient air quality amenity. A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies.

Key Issues and Proposed Mitigation Strategies

Key Issues	Proposed Mitigation Strategy
Construction activities to be located within 10 metres of sensitive receptors.	- Implementation of best practice dust control measures - Locate fixed plant and fuel tanks away from receptors - Compliance with a Construction Environmental Management Plan (CEMP) - Complaints handling and proactive response measures
Increased traffic volumes (particularly on the Hume Highway and Picton Road) predicted for 2021 as a result of the development.	- Traffic/transport initiatives - Road improvements - Setbacks for development - Vegetated buffer placement - Location of sensitive receptors away from busy roads (i.e. the Hume Highway and Picton Road)
Early operations of the Bingara Gorge Sewage Treatment Plant (STP), the proposed Project Wastewater Treatment Plant (WWTP) and associated Sewage Pumping Stations.	- Odour dispersion modelling (STP and WWTP) - Appropriate design and containment - Provision of suitable buffer zones based on the results of odour dispersion modelling - Vegetated buffer placement - Complaints handling and proactive response measures

It is noted that the broad "risk-based" approach adopted for this assessment is designed to provide a conservative overall impact risk, and is not the defining determination for the requirement for mitigation and control.

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Abbreviations and Acronyms

AHD	Australian Height Datum
AQMS	Air quality monitoring station
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CASANZ	Clean Air Society of Australia and New Zealand
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DP&E	Department of Planning and Environment
DGRs	Director-General's Requirements
EETM	Emission Estimation Technique Manual
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
LGA	Local Government Area
µg	microgram ($g \times 10^{-6}$)
µm	micrometre or micron ($metre \times 10^{-6}$)
m^3	cubic metre
m/s	metres per second
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
NO	Nitrous oxide
OEH	NSW Office of Environment and Heritage
OU	Odour Units; concentration of odorous mixtures in odour units. The number of odour units is the concentration of a sample divided by the odour threshold or the number of dilutions required for the sample to reach the threshold. This threshold is equivalent to when 50% of a testing panel correctly detect an odour
PAH	Polycyclic Aromatic Hydrocarbon
PCDD/DF	Polychlorinated dibenzo-*p*-dioxins and furans

$PM_{2.5}$	Particulate matter less than 2.5 microns
PM_{10}	Particulate matter less than 10 microns

Abbreviations

SO_2	Sulphur dioxide
T	tonnes
TVOCs	Total Volatile Organic Compounds
VIC EPA	Victoria Environment Protection Authority
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Compound

Commonly Used Terminology

airshed	The geographical area associated with a given air supply
ambient	Pertaining to the surrounding environment or prevailing conditions
anemometer	An instrument for measuring wind force and velocity
AUSPLUME	A steady state Gaussian dispersion model
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
atmospheric pressure	The force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere
background	The existing air quality in the project area excluding the impacts from the proposed development
baseline monitoring program	A monitoring program designed to measure the ambient concentration levels which currently exist prior to the proposed development
calms	Refers to calm wind speeds of less than 0.5 m/s.
climatological	The science dealing with climate and climatic phenomena
combustion	The process of burning. A chemical change, especially oxidation, accompanied by the production of heat and light
crushers	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwind	The direction in which the wind is blowing

Air Quality Terminology

emission factor	A measure of the average amount of a specific pollutant or material emitted by a specific process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed.
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action.
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mitigate	To moderate (a, quality or condition) in force or intensity; alleviate
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
point source	A pollution source that is fixed and/or uniquely identifiable, such as a stack, chimney, outlet pipe or vent
plume	A space in air, water, or soil containing pollutants released from a point source
pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource
qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops.
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
volatile organic compounds	All organic compounds (substances made up of predominantly carbon and hydrogen) with boiling temperatures in the range of 50-260°C, excluding pesticides. This means that they are likely to be present as a vapour or gas in normal ambient temperatures.
wind direction	The direction from which the wind is blowing
wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time

Emissions Estimation Inventory for Wollondilly LGA

WOLLONDILLY LGA		Substance Emissions (kg/year)								
Category	Activity	BENZENE	CARBON MONOXIDE	LEAD & COMPOUNDS	OXIDES OF NITROGEN	PM10	PM2.5	PAHs	SULPHUR DIOXIDE	TOTAL VOCS
Rural	AgriculRural Burning		7,563	0.01	269	973	928	17.05	41.58	563
	Bushfire and Prescribed Burning		493,590	4.96	14,581	49,716	42,189	118	4,492	34,551
	Fugitive/Windborne			109		74,279	9,930			
	Soil				397,819					
	Vegetation									10,923,910
Rural Total			**501,152**	**114**	**412,669**	**124,968**	**53,047**	**135**	**4,534**	**10,959,024**
Commercial	Automotive Fuel Retailing	889								110,190
	Beer and Malt Manufacturing	4.40	739	4.40E-3	880	66.88	66.88	6.05E-3	4.60	618
	Gravel and Sand Quarrying			0.96		33,924	7,313			3.60
	Hospitals (Except Psychiatric Hospitals)	0.37	61.82	3.68E-4	73.60	5.59	5.59	5.06E-4	0.38	4.05
	Laundries and Dry-Cleaners									3,678
	Poultry Farming (Eggs)					67.25	15.43			
	Poultry Farming (Meat)					23,250	5,334			
	Smash Repairing									3,012
Commercial Total		**894**	**801**	**0.97**	**954**	**57,314**	**12,734**	**6.56E-3**	**4.98**	**117,506**
Domestic-Commercial	Barbeques	30.69	3,893	0.02	744	256	230	3.51	85.47	1,211
	Cutback Bitumen									2,923
	Use of Solvents/Aerosols	0.09						741		205,145
	Gaseous Fuel Burning	0.33	6,441	0.08	14,930	1,191	1,191	0.11	96.49	861
	Graphic Arts							59.23		28,207
	Lawn Mowing Evaporative (Domestic)	364								46,628
	Lawn Mowing Evaporative (Public Open Spaces)	22.09								2,833
	Lawn Mowing Exhaust (Domestic)	2,247	331,825	2.19	1,430	1,918	1,764	22.98	68.75	69,051
	Lawn Mowing Exhaust (Public Open Spaces)	770	115,418	0.59	1,247	880	815	6.74	17.82	26,633
	Liquid Fuel Burning (Domestic)	2.42E-3	57.59	0.01	207	27.41	24.53	0.01	81.78	8.21
	Rural/Town Gas Leakage									22,241
	Solid Fuel Burning (Domestic)	3,500	511,907	7.33	7,689	72,489	69,783	1,282	1,226	76,111
	Surface Coatings							44.16		86,490
Domestic-Commercial Total		**6,934**	**969,542**	**10.22**	**26,247**	**76,762**	**73,808**	**2,160**	**1,576**	**568,343**
Industrial	Cement or lime production	12.27	47,232	42.36	807,682	40,813	37,727	153	8,192	1,279
	Concrete works	1.44	242	2.78	288	6,517	803	1.98E-3	1.50	16.42
	Crushing, grinding or separating		192	13.81		82,499	17,103			1.79
	General agriculRural processing					9,227	2,636			
	Generation of electrical power from gas	1,052	597,341		1,432,268	145	145	49.47	1,107	222,737
	Hazardous, industrial or group A waste D			9.64		21,137	2,114			
	Land-based extractive activity			0.30		14,373	2,695			0.70
	Mining for coal	39.74	68.48	53.04	161	371,779	47,781	1.18E-3	0.89	3,945
	Recovery of waste			2.73E-4		0.42	0.10			
	Sewage treatment - small plants			0.08		131	31.63			44.01
	Slaughtering or processing of animals	3.92	658	0.60	784	985	284	5.39E-3	4.10	693
	Waste disposal (application to land)	18.52	103	1.02		10,900	2,210			2,684
Industrial Total		**1,128**	**645,837**	**124**	**2,241,182**	**558,506**	**113,530**	**202**	**9,305**	**231,402**
Off-Road Mobile	Aircraft (Flight Operations)	6.05	15,760	14.68	696	260	183	6.53	75.13	320
	Commercial Vehicles and Equipment	4.92	1,224	5.12E-3	1,881	162	157	0.17	3.98	239
	Industrial Vehicles and Equipment	341	150,538	0.36	181,154	11,731	11,381	13.89	388	19,918
	Locomotives	43.61	49,471	1.10	332,380	9,328	9,048	24.75	579	19,535
	Recreational Boats Evaporative	1,097								140,583
	Recreational Boats Exhaust	19,203	1,534,265	24.28	31,687	15,059	13,861	36.01	785	750,987
Off-Road Mobile Total		**20,695**	**1,751,257**	**40.41**	**547,799**	**36,540**	**34,630**	**81.36**	**1,832**	**931,582**
On-Road Mobile	All - Evaporative	1,435								222,537
	All - Non-Exhaust PM			62.52		26,824	14,270			
	Heavy Duty Commercial Diesel - Exhaust	279	143,259	3.98	609,007	22,275	21,607	823	1,012	26,111
	Light Duty Commercial Petrol - Exhaust	1,452	497,763	0.33	122,194	938	894	257	481	29,571
	Light Duty Diesel - Exhaust	20.59	12,530	0.74	44,463	4,136	4,012	129	112	1,930
	Others - Exhaust	425	88,438	0.07	7,558	191	182	59.66	29.31	8,576
	Passenger Vehicle Petrol - Exhaust	4,284	1,059,531	0.77	372,077	2,167	2,065	648	2,575	87,257
On-Road Mobile Total		**7,894**	**1,801,522**	**68.41**	**1,155,300**	**56,531**	**43,030**	**1,916**	**4,209**	**375,983**
	Wollondilly Total	**37,544**	**5,670,112**	**358**	**4,384,150**	**910,620**	**330,780**	**4,494**	**21,461**	**13,183,840**
	GMR Total	**37,544**	**5,670,112**	**358**	**4,384,150**	**910,620**	**330,780**	**4,494**	**21,461**	**13,183,840**