Katestone Environmental

AIR QUALITY ASSESSMENT OF THE PROPOSED NORTHEAST BUSINESS PARK, CABOOLTURE

NORTHEAST BUSINESS PARK PTY LTD

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GLOSSARY

AADT	Annual average daily traffic
AGO	Australian Greenhouse Office
AWS	Automatic weather station
BOM	Bureau of Meteorology
DECC	Department of Environment and Climate Change
DMP	Dust Management Plan
$g/m^2/month$	gram per metre square per month
GWP	global warming potential
km	kilometres
$MtCO_2$-e	Mega tonnes carbon dioxide equivalent
$\mu g/m^3$	micrograms per cubic metre
μm	micrometre
NEBP	North East Business Park
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory
NSW EPA	Environmental Protection Agency, New South Wales
ou	odour units
VIC EPA	Environmental Protection Authority Victoria

Executive Summary

Katestone Environmental has been commissioned by Northeast Business Park Pty Ltd to conduct an air quality assessment of the proposed Northeast Business Park (NEBP), Caboolture. The proposed NEBP will be located along the Caboolture River adjacent to the Bruce Highway approximately 40 kilometres north of Brisbane.

The purpose of the NEBP is to develop a multi-use precinct, incorporating a Business Park, light industry, a marina, mixed density residential and a golf course.

An air quality study has been undertaken that addresses the Terms of Reference for the project and includes:

- *A description of environmental values, including meteorology and background levels of pollutants; and*
- *An assessment of potential impacts against the relevant state goals and guidelines and identification of mitigation measures.*

The key findings of the air quality study were the following:

- *During construction it is essential that good dust control and management is implemented to ensure that the potential for dust nuisance is minimised. A dust management plan should be implemented for the construction phases.*

- *Existing air quality at the NEBP site is likely to be within ambient air quality standards and, therefore, does not provide a major constraint for development.*

- *The air conditioning intakes on buildings should be located where truck movement or idling engine emissions cannot adversely affect the indoor air quality. A separation distance of at least 20 metres is recommended from internal roadways to buildings.*

- *In addition air condition intakes should be located away from the proposed Marine industry precinct to avoid potential odour nuisance.*

- *New industries should be designed and operated to ensure compliance with air quality standards and to minimise air pollutants to the maximum extent that is economically feasible. Current air pollution regulations such as the NSW Clean Air Regulation provide guidance on this.*

- *Industries with particular requirements for low air pollution (such as food storage, food manufacturing or pharmaceutical manufacturing facilities) should not be located close to the proposed transport corridor or Marine Industry Precinct.*

- *Potential businesses such as small goods and warehousing, that will not produce significant quantities of air pollutants, should not need to individually assess their air emissions.*

- *Notwithstanding the above, there may be a requirement for detailed air quality assessments for proposals that are subject to integrated development assessment processes and permits of Council and the Environment Protection Agency.*

1. Introduction

Katestone Environmental has been commissioned by Northeast Business Park Pty Ltd to conduct an air quality assessment of the proposed Northeast Business Park (NEBP), Caboolture. The proposed NEBP will be located along the Caboolture River adjacent to the Bruce Highway approximately 40 kilometres north of Brisbane.

The purpose of the NEBP is to develop a multi-use precinct, incorporating a Business Park, light industry, a marina, mixed density residential and a golf course.

1.1 Scope of works

The exact nature of all activities that will be located in the NEBP has not been predetermined and will depend on the needs of individual purchasers. Consequently a detailed assessment of the potential air quality impacts of individual businesses and light industries on surrounding sensitive land uses cannot be undertaken. The industrial precinct will be zoned for General Industry and consequently will include activities involved in transport, warehousing, manufacturing and packaging. Such activities will have a relatively minor potential for affecting air quality. A generic air quality assessment has been undertaken for the purposes of this study.

This report will address the Terms of Reference for the project and discuss general air quality implications due to the construction and operation of the NEBP. The Terms of Reference addressed in this report are:

- A description of environmental values, including meteorology and background levels of pollutants; and
- An assessment of potential impacts against the relevant state goals and guidelines and identification of mitigation measures.

1.2 Limitations of study

The main limitations of the current study are in association with the reliability and accuracy of the data sets which form the basis of the modelled scenarios, as well as the use of the numerical modelling tool Ausplume.

This study necessarily relies on the accuracy of a number of data sets including, but not limited to:

- Meteorological information;
- Construction emission rates of pollutants; and
- Details of cut and fill operations during construction.

A number of assumptions have been applied. These include, but are not limited to:

- Ambient air monitoring data obtained from an existing monitoring site is representative of air quality within the study region;
- Projected construction traffic volumes will be an accurate representation of construction activities;
- Projected volumes of cut and fill will be an accurate representation of construction operations; and
- Due to limited observational data a synthesised meteorological data file was used.

It is important to note that all numerical models that are based on approximating a governing set of equations will inherently be associated with some degree of error. The more complex the physical model, the greater the number of physical processes which must be parameterised. This frequently results in a large number of tune-able parameters within the model. There exists extensive in-house expertise in the use of Ausplume within Katestone and our modellers make every reasonable attempt to ensure that model results are of the highest possible quality.

2. Framework for air quality management

The Queensland Government's objective in relation to air quality is defined under Section 3 of the Environmental Protection Act 1994. The object is to protect Queensland's environment while allowing the development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

The EP Act gives the Environment Minister the power to create Environmental Protection Policies that identify and aim to protect environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. The Environmental Protection (Air) Policy (EPP(Air)) was gazetted in 1997. The administering authority must consider the requirements of the EPP(Air) when it decides an application for an environmental authority, amendment of a licence or approval of a draft environmental management plan.

The objective of air quality management is to ensure that discharge of air pollutants to the atmosphere are managed and controlled so as to avoid environmental harm, as defined under the Act. This can be achieved through:

- Controlling emissions at the source, via emission limits and environmental management;
- Ensuring sufficient separation distances to avoid residual impacts and to reduce the risk of impact during upset conditions; and
- Controlling impacts at the receptor.

A formal development assessment process is required to be undertaken for all activities, that incorporates air quality assessment for those activities, that have a significant potential for adverse air quality impacts. The assessment process determines whether environmental harm could occur at nearest sensitive locations and the controls and management that should be implemented to avoid such impacts. The potential for environmental harm is usually determined via a quantitative air quality study and comparison against the goals that are specified in the EPP(Air). These are discussed further in Section 5.1.

The extent of control of emissions of air pollutants is usually defined by regulatory emission limits. Activities that implement contemporary design standards to achieve these regulatory emissions will minimise the potential for adverse impacts. Regulatory emission limits are discussed further in Section 6.1.

Where full details of a proposal are not known or are yet to be defined, guidelines on separation distances can be used as a preliminary bases for assessing whether proposed land uses are compatible and sufficiently separated to avoid adverse air quality impacts. These are discussed in Section 6.2.

In this instance, the exact nature of industries within the Business Park and activities in the Marina Precinct are unknown and therefore a site specific assessment cannot be undertaken at this stage. However, if preliminary design ensures compliance with the limits specified in Section 6.1 and the sensitive land uses in accordance with the distances shown in Section 6.2, adverse air quality impacts are unlikely to occur. Notwithstanding this, the Caboolture Shire Council and Environmental Protection Agency may require that a site specific assessment is undertaken in conjunction with development applications for new activities that could affect air quality in the NEBP and beyond.

The NEBP in meeting their key messages and value statement of Environmentally Sustainable Development (ESD) are unlikely to support activity by businesses which are know to have significantly adverse impacts on the receiving airshed given the objective of creating a community focused development (except for where ship maintenance activities are proposed).

Details are known on construction activities and traffic volumes within the NEBP. Therefore a qualitative assessment has been undertaken to determine the resulting impact on air quality these activities may have.

3. Project description and location

3.1 Project description

The NBP site is located approximately 40 kilometres north of Brisbane, near Burpengary and lies within the Caboolture Shire local government area. The site is relatively flat. The site was formally a pine plantation, now degraded, and bounded to the north by the Caboolture River to the west by the Bruce Highway and to the east by the coastline. The NEBP site encompasses 793 hectares of property which includes the following six land parcels ("the project area"):

- Lot 2 on RP902075;
- Lot 10 on RP902079;
- Lot 24 on SP158298;
- Lot 7 on RP845326;
- Lot 15 on RP902073; and
- Lot 12 on RP145197.

The site is zoned District Industry and Rural under the Caboolture Shire Council Plan. Immediately to the south and north of the site, land is zoned as Rural Residential. To the west (western side of the Bruce Highway) land is zoned predominately as Residential A with some areas of Open Space and Rural Residential.

Figure 1 illustrates the proposed layout of the NEBP. The 760 hectare site will comprise of:

- Marina basin;
- Marine industry;
- Industrial;
- Commercial/mixed use;
- Residential;
- Apartments;
- Townhouses;
- Hotels;
- Golf residential;
- Environmental open space;

- Golf course;
- Recreational areas and sporting fields; and
- Heritage park.

Of the 793 hectares, 44% (350 ha) will be developed. The business park is situated on the land that is zoned for District Industry and is expected to comprise of small, medium and large lots that will incorporate activities that are consistent with the general industry zoning such as logistics, warehousing and light industry.

The remaining area (443 ha) will be set aside for open space, and active and passive recreational uses, including a heritage park. The project area is located on 9 kilometres of river frontage which will provide public access to parts of the Caboolture River.

4. Topography and meteorology

On a regional scale the surrounding terrain is quite complex. The proposed Northeast Business Park is located 5 kilometres inland from the coast and 25 kilometres from the D'Aguailar Ranges. The topography of the NEBP is relatively flat with the business park the highest point of the development and the elevation decreasing closer to the river.

The nearest meteorological station to the NEBP is the Queensland Environmental Protection Agency's Deception Bay monitoring station situated 10 kilometres to the southeast of the NEBP. Records of wind speed and wind direction from the site commenced in January 1995. No other meteorological parameters are recorded at this site.

The nearest long-term record of climatic conditions is available from the Bureau of Meteorology station at the Brisbane Airport, approximately 30 kilometres from the NEBP. The Bureau of Meteorology has conducted monitoring at Brisbane Airport for many years. An automatic weather station capable of recording half-hourly average wind speed, direction, temperature, dewpoint, relative humidity and pressure was installed in July 1994. The data have been included in the climate assessment covering the periods from July 1994 to May 2007. Monthly rainfall has also been summarised.

4.1 Temperature, humidity, rainfall and atmospheric pressure

Figure 2 and Table 1 illustrate the average maximum and minimum temperatures for each month as well as the average monthly temperature. The hottest 1-hour average temperature recorded between 1992 and May 2007 was 40.2ºC in February 2004. The coldest 1-hour average temperature recorded between 1992 and May 2007 was 1.6ºC in July 2002.

Table 1 presents monthly average relative humidity, atmospheric pressure and rainfall. Relative humidity is the highest in June averaging 70% and lowest in September average 58%. Atmospheric pressure varies throughout the year with higher averages occurring in the winter. The highest monthly average rainfall occurs in summer in December with 131 mm. The lowest monthly average rainfall occurs in winter with the lowest average of 26.4 mm occurring in July.

Table 1: Monthly averages for various meteorological parameters for the period from July 1994 to May 2007 for temperature, relative humidity, atmospheric pressure and rainfall.

	Average temperature (ºC)	Average relative humidity (%)	Average pressure (hPa)	Monthly total average rainfall (mm)
January	24.9	73.0	1012	120.9
February	24.9	73.9	1013	111.2
March	23.6	73.9	1015	80.6
April	21.0	74.4	1019	56.6
May	17.9	74.0	1019	119.2
June	15.5	73.5	1020	63
July	14.5	70.2	1021	26.11
August	15.6	69.4	1020	37
September	18.5	70.0	1019	33.5
October	20.7	70.4	1016	71.9
November	22.1	71.7	1016	105.9
December	23.9	72.1	1013	131/1

4.2 Wind speed and wind direction

Wind flows in the area are important for understanding the capacity of the air to disperse air pollutants. For odour impacts, worst-case meteorological conditions are generally light winds during the evening or early morning. Wind speed is also important for dust emissions from the site during the construction phase. Exposed dust sources, such as stockpiles or exposed land will have higher dust emissions during strong winds than during light winds. During strong winds, dust particles are more likely to be lifted by the wind and carried further off-site than during light winds. For tall stacks (about 50 metres or more) convective conditions (highly unstable conditions) have the tendency to bring a plume to ground, resulting in elevated ground-level concentrations. These conditions generally occur during the day.

Figure 3 and Figure 4 illustrate the distribution of winds based on data collected at the Brisbane Airport (BoM) and Deception Bay (Qld EPA) for the period July 1994 to May 2007 and January 1995 to August 2005, respectively. Figure 5 and Figure 6 show the distribution of winds based on time of day. The winds at Brisbane Airport are stronger than the winds reported at Deception Bay. This is likely to be due to the location of the monitoring station in a relatively clear area compared with the Deception Bay monitoring station. Light to moderate southwesterly winds dominate in the early morning at Deception Bay, before strengthening during the day and becoming northeasterly and east-southeasterly winds signalling the arrival of the seabreeze. In the evening winds become lighter. At both monitoring stations moderate to strong northeasterly and east-southeasterly winds dominate in summer and spring. Light to moderate southwesterly winds prevail in spring and winter.

The high frequency of light winds from the southwest will transport fugitive releases of, say, odours or exhaust emissions from boats to the northeast. As there is good buffering in this direction, there is a low risk of nuisance associated with fugitive releases of air pollutants from the NEBP. Any activities with fugitive releases of odour or air pollutants should be placed on the northeast edge of the business park.

The high frequency of stronger winds from the northeast to east-southeast could be important for exposed areas/dusty activities. As these winds are more prevalent in the afternoon, dust control and management should be focused during this time on prevention of dust nuisance at residences to the southwest.

5. Guidelines and background air quality

5.1 Air quality standards, goals and guidelines

Schedule 1 of the EPP(Air) specifies air quality indicators and goals for Queensland. Indicators and goals for particulates and nitrogen dioxide are reproduced in Table 2.

National standards and goals for air quality are set by agreement between the Federal and State Governments through the National Environment Protection Council (NEPC) and published in the National Environment Protection Measure (NEPM) for Ambient Air Quality. They deal with exposure of the general population to air pollutants and protect against adverse health effects due to carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3) and particulate matter with aerodynamic diameter less than 10 µm (PM_{10}). In 2003, the NEPM was revised to include an advisory reporting standard for $PM_{2.5}$ (particulate matter with aerodynamic diameter less than 2.5µm).

These pollutants are relevant because they commonly occur due to direct emissions from industry, traffic and domestic activities and are generally used as indicators of urban air pollution. There are many other air pollutants that are identified for their odorous or toxic properties. Ambient air quality standards are defined for some in the Victorian State Environment Protection Policy (2001) and some in the air toxics NEPM. These pollutants are less common, and tend to be considered on site-specific basis.

Deposition of particulate matter can result in dust nuisance and reduced public amenity, or example due to soiling of clothes, building surfaces and other surfaces. This is most commonly an issue during construction activities. The dust deposition guideline in Table 2 is not defined in the EPP(Air), but has been recommended by the EPA as a design goal for avoiding nuisance.

Table 2: Impact assessment criteria for criteria pollutants (EPP(Air), 1997)

Pollutant	Averaging period	Concentration	Units
Sulphur dioxide	10-minute	700	$\mu g/m^3$
	1-hour	570	$\mu g/m^3$
	24-hour	100/228	$\mu g/m^3$
	Annual	60	$\mu g/m^3$
Nitrogen dioxide	1-hour	320/246	$\mu g/m^3$
	Annual	30/62	$\mu g/m^3$
Carbon monoxide	8-hour	10,000/11,247	mg/m^3
Particulate matter (diameter <10 μm) (PM_{10})	24-hour	150/50	$\mu g/m^3$
	Annual	50	$\mu g/m^3$
Particulate matter (diameter <2.5 μm) ($PM_{2.5}$)	24-hour	25*	$\mu g/m^3$
	Annual	8*	$\mu g/m^3$
Total suspended particulates (TSP)	Annual	90	$\mu g/m^3$
Deposited dust	Annual	120	$mg/m^2/day$
Note: NEPM advisory reporting standard.			

Recommendations for assessing and managing odour from new developments in Queensland are detailed in the Queensland EPA's odour guideline (2004). The guideline is intended for application to new developments and should be used to assess the suitability of any odorous activity that may be located in the NEBP. Odour is measured in odour units (ou), based on the Australian Standard method (2001). The odour guideline differentiates between the type of source, with the guideline for tall wake-free stacks set at 0.5 ou for 99.5th percentile, 1-hour average. Ground-level sources and plumes that are affected by building wakes should comply with a guideline of 2.5 ou for a 99.5th percentile, 1-hour average.

The odour guideline applies to odour sensitive places that include: residences, schools, hospitals, caravan parks, national parks, shops and business premises that may be affected by odour.

Industrial and infrastructure projects should be designed and operated to ensure that environmental nuisance and environmental harm do not occur. The air quality standards, goals and guidelines described above are commonly used as a benchmark for ensuring that the potential for harm is minimised.

5.2 Existing ambient air quality

The area surrounding the proposed site is currently used for residential and rural purposes. A pine plantation is located in the immediate area. Within 1 kilometre of the site to the north is an industrial area that includes industries such as product wholesale of petroleum. An airport is located 2.5 kilometres to the north.

The Bruce Highway is a source of air pollutants that may affect the site. The Bruce Highway is located 50 metres to the west of the Business Park area of the NEBP development. The main pollutants with implications for human health that are emitted by motor vehicles include carbon monoxide, oxides of nitrogen, particulate matter and volatile organic compounds. Previous air quality assessments by Katestone Environmental for highways and bypasses have shown that at 10 metres from the road impacts have fallen to less than 67% of the corresponding air quality goals. Whilst the Bruce Highway is expected to be an important source of air pollutants, it is well separated from the business park and residential areas and consequently the ground-level concentrations of air pollutants associated with it will be well below air quality standards and goals.

There are a number of existing industrial facilities within Caboolture Shire including poultry farms, log saw milling, gravel and sand quarrying, wood product manufacturing, pet food preparation and petroleum storage (NPI 2007). The NEBP is well removed from these sources and the existing air quality is unlikely to be greatly influenced by industrial emissions.

A number of facilities reported to the National Pollutant Inventory in 2004-2005. A total of 23 substances were reported. All facilities have relatively low emission rates of all the reported substances, compared to other facilities in Australia.

A background dust level is required for the modelling to represent all regional sources. The Queensland EPA's monitoring site at Mountain Creek is the nearest available source of data that is likely to be representative of the NEBP site. Data from Mountain Creek, for the period of 2001 to 2005, were analysed to determine a suitable background level of PM_{10}. The 24-hour average, 95th percentile, and annual average background concentrations used in this assessment are 30 $\mu g/m^3$ and 17 $\mu g/m^3$, respectively.

TSP is not recorded at any of the EPA monitoring stations. Previous assessments by Katestone Environmental using data collected in Brisbane have found PM_{10} to average around 70 % of the TSP concentration. This ratio has therefore been employed here giving an annual average background level of 24.2 $\mu g/m^3$ for TSP.

There are no known measurements of dust deposition rate within the NEBP area. A background of 20 mg/m^2/day has been used in this assessment based on information collected in Southeast Queensland.

6. Air quality considerations for new activities

Design, management and siting of new activities are key features in avoiding adverse air quality impacts. New activities to be located in the NEBP should be designed to minimise the emission of air pollutants to the maximum extent achievable considering economic viability and proximity to sensitive land-uses. The following sections provide recommendations for control of air pollutants from new plant and equipment and suggested buffer distances that should be maintained to minimise the potential for adverse air quality impacts.

6.1 Emission standards

The Queensland EPA commonly requires an assessment of new industries against best practice environmental management for new industrial sources of air pollutants. In undertaking such an assessment the Queensland EPA relies upon the ANZECC/NHMRC guidelines (1985) and more recent regulations from other state jurisdictions. The NSW DECC Clean Air Regulation (2002) provides emission regulations for a wide range of industrial sources of air pollutants. Whilst these emission regulations are not legally binding in Queensland, they provide the most comprehensive set of emission regulations in Australia and have been used by the Queensland EPA in the past as a benchmark for new activities.

For most activities recommended limits are specified in Table 3.

Table 3: Emission standards from Schedule 4, standards of concentration for stack emissions from scheduled premises: general activities and plant *Clean Air Regulation 2002*

Air impurity	Activity or plant	Standard of concentration
Solid particles (Total)	Any activity or plant (except as listed below)	50 mg/m^3
	Any plant used for heating metals	50 mg/m^3
	Any crushing, grinding, separating or materials handling activity	20 mg/m^3
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Any activity or plant (except boilers, gas turbines and stationary reciprocating internal combustion engines listed below)	350 mg/m^3
	Any boiler operating on gas	350 mg/m^3
	Any boiler operating on a fuel other than gas, including a boiler used in connection with an electricity generator that forms part of an electricity generating system with a capacity of less than 30 MW	500 mg/m^3
	Any turbine operating on gas, being a turbine used in connection with an electricity generating system with a capacity of less than 10 MW	70 mg/m^3
	Any turbine operating on gas, being a turbine used in connection with an electricity generating system with a capacity of 10 MW or greater but less than 30 MW	70 mg/m^3
	Any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of less than 10 MW	90 mg/m^3
	Any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of 10 MW or greater but less than 30 MW	90 mg/m^3
	Stationary reciprocating internal combustion engines	450 mg/m^3
Sulphuric acid mist (H_2SO_4) or sulphur trioxide (SO_3) or both, as SO_3 equivalent	Any activity or plant	100 mg/m^3
Hydrogen sulphide (H_2S)	Any activity or plant	5 mg/m^3
Chlorine (Cl_2)	Any activity or plant	200 mg/m^3
Hydrogen chloride (HCl)	Any activity, other than the manufacture of glazed terracotta roofing tiles	100 mg/m^3
	Manufacture of glazed terracotta roofing tiles	100 mg/m^3
Type 1 substances and Type	Any activity or plant	1 mg/m^3

Air impurity	Activity or plant	Standard of concentration
2 substances (in aggregate)		
Cadmium (Cd or mercury (Hg) individually	Any activity or plant	0.2 mg/m^3
Volatile organic compounds (VOCs), as n-propane	Any activity or plant involving combustion (except as listed below)	40 mg/m^3 VOCs or 120 mg/m^3 CO
	Any stationary reciprocating internal combustion engine using a gaseous fuel	40 mg/m^3 VOCs or 125 mg/m^3 CO
	Any stationary reciprocating internal combustion engine using a liquid fuel	1140 mg/m^3 VOCs or 5880 mg/m^3 CO
Note: [1] Type 1 substances include antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. [2] Type 2 substances include beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or an compound containing on or more of those elements.		

6.2 Separation distances

Whilst under normal circumstances industrial facilities will comply with emission standards and ambient air quality goals, there are occasions when upset conditions may result in elevated concentrations of pollutants and/or odour. Separation distances assist in mitigating the impact of upset conditions at sensitive locations by allowing a greater distance over which emissions are dispersed. Separation distances are also used as a screening level air quality assessment tool for small activities that may not be subject to detailed assessment processes.

Several Australian states have proposed the use of separation distances to protect more sensitive land uses from adverse air pollution. These separation distances are not an alternative to emission management and controls but provide a generic statement of the risk of adverse impacts. The Queensland EPA refers to the separation distances that were developed by the Victorian EPA for use in Queensland.

The Victorian EPA has developed guidelines that provide recommendations for the minimum separation distances required between sensitive land uses and industries to avoid adverse impacts. Separation distances for general industrial activities that could have the potential to impact air quality are listed in Table 4.

Table 4: Recommended buffer distances to protect residential landuses from potential air quality impacts from industries (VIC EPA, 1990).

Activity	Recommended separation distance (m)
Manufacturing, food, beverages, tobacco	
Smallgoods	100
Milk products	100
Bakeries	100
Chemical, Petroleum and coal products	
Formaldehyde production	300
Paints and ink -blending and mixing	300
Cosmetic and toilet paper preparations	100
Pharmaceutical and veterinary products	1,000
Non-metallic mineral products	
Glass and glass products	500
Bricks, tiles, pipes etc with production rate exceeding 10,000 tonnes per annum	200
Concrete batching plants	100
Plaster products	100
Basic metal products	
Iron and steel production up to 1,000,000 tonnes per year	500
Miscellaneous manufacturing	
Fibreglass manufacturing	200
Transport and storage	
Transfer stations	300
Non-metallic mineral products	
Concrete batching plants	100
Bitumen batching plants	500
Plaster products	100
Concrete or stone articles	100

Activities such as warehousing, logistics and storage that have a low risk of causing significant emissions of air pollutants do not require buffers as large as those shown in Table 4. Such activities can be located within the intervening buffers between sensitive landuses and industries with a greater potential for impact.

Various industries require different separation distances ranging from 100 metres to 1,000 metres. Careful planning within the NEBP with regard to siting of the various industries would assist in minimising impacts on sensitive receptors. These activities may be subject to site-specific air quality impact assessment study in accordance with the requirements of the relevant government authority particularly if they are an Environmentally Relevant Activity under the Environmental Protection Regulation 1998. Such assessment studies will ensure that appropriate controls are implemented to ensure adverse impacts do not occur.

Roads within the District Industry zone of the NEBP are likely to carry a higher proportion of heavy vehicles due to the nature of the tenancies. Emissions from vehicles idling and accelerating generate elevated levels of air pollutants, notably particulate matter. The location of buildings and air conditioning intakes should consider the potential impacts of these vehicle emissions. A set-back distance of at least 20 metres between roads and buildings or air intakes should be maintained to prevent deterioration of air quality within offices in the NEBP. Vehicle management on the NEBP should include minimising vehicle idling time.

Premises that have particular requirements for indoor air quality, such as food storage, food manufacturing or pharmaceutical manufacturing, may need more stringent protection from air pollution, and assessment on a case-by-case basis is suggested.

All industries should investigate opportunities to reduce air emissions through the application of waste prevention and minimisation, cleaner production and best practice environmental management.

7. Air quality implications during construction

Construction of the NEBP infrastructure and buildings has the potential to cause elevated levels of dust if it is not appropriately managed. The relatively high wind speed nature of the site increases the potential for elevated dust levels, and therefore dust minimisation and management strategies should be implemented from the commencement of construction is essential.

Dust management should include regular watering of roads and exposed areas to reduce wheel-generated dust, and restricting vehicle speeds to below 40 kilometres per hour. During high wind conditions, dust-generating activities such as earthworks, which could potentially affect the residences located to the south and west of the proposed site, should not be carried out. Haul vehicles should be covered when moving outside the construction site, and any spillages promptly cleaned up. Long-term stockpiles should be revegetated to prevent wind erosion. Regular cleaning of machinery and vehicle tyres will prevent track-out of dust to public roads. Burning or incineration of cleared vegetation or other materials should not be carried out on site at any time.

Before construction commences a dust management plan (DMP) should be developed to assist in minimising nuisance dust. The NSW EPA and Parramatta City Council have developed a *No Dust No Fuss Booklet - Guidelines for Controlling Dust from Construction Sites* and *No Dust No Fuss Fact sheets* (http://www.parracity.nsw.gov.au/publications/) that detail the information that should be included in a dust management plan as well as dust measures that will assist in minimising dust from construction activities. Dust measures included are:

- Limiting the amount of cleared area;
- Erecting physical barriers ;
- Site traffic control
- Earth moving management;
- Watering sprays;
- Soil compaction; and
- Vegetative stabilisation

If on-site concrete batching plants, bitumen or asphalt plants are required, these may be a source of dust, odour and other air pollutants. Site-specific air quality assessments should be undertaken if these activities are to be located within close proximity of sensitive land-uses.

A detailed environmental management plan should be prepared that provides recommendations for monitoring and control of dust emissions during construction.

8. Air quality assessment

8.1 Construction

Construction has the potential to cause elevated levels of dust if not appropriately managed. Two and a half million tonnes of material is to be extracted from parts of the NEBP site and redistributed to other parts of the NEBP site.

Construction will be undertaken in three phases. The first phase will involve filling the area designated for the industrial park to the Q100 level. The second and third phase will involve development of the marina and levelling of the proposed residential area. Due to the large amount of material being moved around the site dispersion modelling has been undertaken to determine the likelihood of a nuisance being caused during construction and to provide a basis form implementing dust control measures.

8.1.1 Emissions

The main activities associated with the earthworks are:

- Bulldozing;
- Scrapers removing topsoil;
- Scrapers unloading topsoil;
- Loading of excavated material;
- Wheel generated dust due to transport of material from cut area to fill location;
- Dumping of fill material;
- Compacting; and
- Wind erosion of exposed areas and stockpiles.

Dust emissions have been calculated from published emission factors based on the USEPA (1995) AP42, Fifth Edition, Volume 1, Stationary Point and Area Sources:

- Chapter 11.9 Western Surface Coal Mining (1998); and
- Chapter 13.2.2 Unpaved Roads (2006).

This information was supplemented by advice on feasible controls, and operational parameters supplied by the construction manager for the NEBP.

Emission factors are presented in Table 5.

Table 5: Emission factors used in the modelling of construction activities at the proposed Northeast Business Park.

Activity	Units	TSP	PM_{10}
Bulldozing	kg/hr	1.37	0.26
Scrapers unloading topsoil	kg/Mg	0.02	0.04
Scrapers removing topsoil	kg/Mg	0.029	0.005
Haulage	g/VKT	2884	804
Truck dumping fill	kg/Mg	0.018	0.003
Compacting	kg/hr	1.37	0.26
Wind erosion of stockpiles and exposed areas	Mg/ha/yr	0.85	0.425

In calculating the emission rates of TSP and PM_{10} the following assumptions were made:

- Moisture content is 10% (range of 7 – 14%).
- Water is sprayed on the haul roads at a rate of 2 L/m2/hr resulting in a 50% control.
- Stabilisation of material to reduce emissions by 30%.

Emission rates are presented in Table 6. The main sources of dust are haul road activities and wind erosion.

Table 6: Emission rates used in the modelling of construction activities at the proposed Northeast Business Park

Activity	TSP	PM_{10}
Bulldozing	0.38	0.07
Scrapers unloading topsoil	1.06	0.29
Scrapers removing topsoil	0.77	0.21
Haulage	5	2
Truck dumping fill	0.67	0.26
Compacting	0.53	0.25
Wind erosion of stockpiles and exposed areas	1.7	0.8

8.1.2 Results

Dispersion modelling was undertaken using the Ausplume model (version 6) for the three phases of construction for TSP, PM_{10} and dust deposition.

A meteorological file suitable for inclusion in the model was created using the CSIRO prognostic model TAPM. Meteorological data from the EPA's Deception Bay monitoring station and the BoM's Brisbane Airport monitoring station were included as data assimilation in TAPM.

A background dust level is required for the modelling to represent all regional sources. The Queensland EPA's monitoring site at Mountain Creek is the nearest available source of data that is likely to be representative of the NEBP site. Data from Mountain Creek, for the period of 2001 to 2005, were analysed to determine a suitable background level of PM_{10}. The 24-hour average, 95th percentile, and annual average background concentrations used in this assessment are 30 $\mu g/m^3$ and 17 $\mu g/m^3$, respectively.

TSP is not recorded at any of the EPA monitoring stations. Previous assessments by Katestone Environmental using data collected in Brisbane have found PM_{10} to average around 70 % of the TSP concentration. This ratio has therefore been employed here giving an annual average background level of 24.2 µg/m³ for TSP.

There are no known measurements of dust deposition rate within the NEBP area. A background of 20 mg/m^2/day has been used in this assessment based on information collected in Southeast Queensland.

Overall the results illustrate that levels of dust predicted to occur at residences are below relevant goals and guidelines. However, it is essential that good dust control and management be carried out at all times during the construction phase in order to prevent dust nuisance. Daily visual observations of dust levels should be made and appropriate controls implemented where necessary. An assessment against the EPA's goals is presented in the following sections.

8.1.2.1 24-hour and annual average PM_{10}

The predicted maximum 24-hour average ground-level concentrations of PM_{10} for Phases 1 to 3 are presented in Figure 9(a), (b) and (c) respectively. The figures illustrate that ground-level concentrations of PM_{10} are predicted to be lower than 130 µg/m^3 for Phase 1 and 3 of construction at all locations outside the NEBP site, with the inclusion of a background of 30 µg/m^3. In sensitive areas, the highest predicted ground-level concentrations are at residences to the south of the site. These are below air quality goals and are unlikely to result in adverse impacts.

For Phase 2, the maximum 24-hour average ground-level concentrations of PM_{10} are predicted to be below the EPP(Air) goal of 150 µg/m^3 at nearby residences. PM_{10} concentrations are predicted to be between 140 and 148 µg/m^3, at the residences to the south.

Figure 10 (a), (b) and (c) present the annual average ground-level concentrations of PM_{10} due to construction during Phases 1 to 3. All figures illustrate that the annual average air quality goals are met outside the site boundary with the maximum of 39 µg/m^3 predicted at a residence with the inclusion of a background of 17.0 µg/m^3.

8.1.2.2 Total suspended particulates (TSP)

The annual average ground-level concentrations of TSP predicted due to the construction Phases 1 to 3 are presented in Figure 11 (a), (b) and (c). There are no exceedances of the EPP(Air) goal of 90 µg/m^3 predicted to occur at a residence. The maximum annual average ground-level concentration of TSP predicted to occur at a residence is 76 µg/m^3, with the inclusion of 24.2 µg/m^3 as a background.

8.1.2.3 Dust deposition rate

Figure 12 (a), (b) and (c) illustrate the annual average dust deposition rate predicted due to construction Phases 1 to 3. The maximum dust deposition rate predicted to occur off site is 120 mg/m^2/day. The maximum predicted at a residence is 113 mg/m^2/day, below the recommended guideline of 120 mg/m^2/day.

8.2 Childcare centre

The Caboolture Shire Council currently does not have specific guidelines for assessing the suitability of air quality at proposed childcare centres.
The Brisbane City Council (BCC) has developed guidelines for assessing the suitability of air quality at proposed childcare centre sites. The guideline specifies three levels of assessment depending on the risk of adverse impact: Low-Risk, Medium-Risk and High-Risk scenarios. The risk level relates to the proximity of the proposed childcare centre to common urban activities that could be associated with adverse air quality impacts. These activities include: major roads, intersections, industry and service stations. Each level of assessment has specific assessment criteria and, depending on whether or not the criteria can be complied with, a more detailed assessment may be necessary. The assessment hierarchy is summarised in Table 7.

Table 7: Assessment criteria: low, medium and high risk for child care centres

Criteria	Low risk	Medium risk	High risk
Distance from road carrying greater than 15,000 vehicles per day	> 40 metres	>20 metres and <40 metres	<20 metres
Distance from controlled intersection and roundabout incorporating suburban road or arterial road	>100 metres	<100 metres	<50 metres
Distance from industry or service station	>150 metres	>100 metres and <150 metres	<100 metres

If the Low-Risk criteria are satisfied, no further assessment is required. If one of the Medium-Risk criteria or High-Risk criteria is satisfied a detailed air quality assessment including dispersion modelling may be required.

The most suitable locations for the childcare centre within the NEBP would be the location that satisfies the criteria for a low risk site. Should these conditions not be satisfied a detailed air quality assessment will be required once type and location of various industries are confirmed within the NEBP.

8.3 Marine industry

The marine industry precinct of the NEBP will incorporate a shipyard with a travel lift, abrasive blasting and specialist paint and maintenance activities as well as a refueling station.

Activities such as abrasive blasting, spray painting, refueling and fibre glassing have the potential to emit odorous and noxious compounds that could cause nuisance at neighbouring residential areas, depending on the distance between the residences and the marine industry, local meteorological conditions and operating conditions within the marine industry precinct and associated facilities. The development permit and registration certificate issued to these facilities usually includes a general requirement to ensure that no offensive odours or elevated pollutant levels occur beyond the boundary of the facility and/or at the nearest residential locations.These activities may be subject to site-specific air quality impact assessment study in accordance with the requirements of the relevant government authority particularly if they are an Environmentally Relevant Activity under the Environmental Protection Regulation 1998. Such assessment studies will ensure that appropriate controls are implemented to ensure adverse impacts do not occur.

8.4 Traffic within NEBP

8.4.1 Traffic volumes

The primary access to the NEBP will be from Buchanan Road which currently serves as the connection between the Bruce Highway and Morayfield Road. Vehicles travelling to the Business Park will be the main source of traffic. Secondary access to the site will by via Buckley Road. This is likely to service the residential areas and marina precinct.

A preliminary traffic report was prepared by Cardno Eppell Olsen in February 2007 for the NEBP. Traffic volumes from that report are reproduced below.

On completion of the development it is expected that 37,921 vehicles per day will access the site. Seventy percent of these vehicles will travel to the Business Park, 26% will be due to residential traffic and the remaining 4% will access the marina, childcare centre and golf course.

The predicted peak AM and PM traffic volumes accessing the site via Buchanan and Buckley Roads for 2025 with and without the proposed NEBP are presented in Table 8.

Table 8: Peak am and pm traffic volumes accessing the site via Buchanan and Buckley Roads for 2025 with and without the proposed NEBP. (heavy vehicles)

Road	Time of day	2025 without NEBP (vpd)	2025 with NEBP
Buchanan Road	am	43 (5)	2344 (136)
	pm	96 (5)	1165 (136)
Buckley Road	am	153 (8)	288 (7)
	pm	372 (23)	575 (24)

8.4.2 Separation distances

In previous work conducted by Katestone Environmental separation distances were calculated using the CAL3QHCR dispersion model for a generic road with free-flowing or congested traffic conditions and for an intersection. The separation distances have been calculated for various daily average traffic flows (AADT) and assuming a generic traffic profile featuring a morning and afternoon peak hour (Figure 13).

The separation distance has been determined as the distance from the road edge to a point where predicted ground-level concentrations of each air pollutant comply with the air quality goals. An allowance has been made for background air quality.

Nitrogen dioxide is the air pollutant from motor vehicles that requires the largest separation distances. Table 9 presents recommended separation distances for free-flowing and congested traffic. The vehicle speed for free-flowing roads was set at 60 km/hr, while the vehicle speed for congested traffic conditions was set to 30 km/hr.

If it was assumed that:

- 40,000 vehicles access the road daily;
- 10% of vehicles are heavy vehicles (e.g. trucks);
- the road is congested; and
- the road gradient is zero

the minimum separation distance that is required is four to ten metres.

It is unlikely that traffic that is associated with the NEBP will cause an adverse impact at existing residential locations as they tend to be set back from the road at distances greater than 27 metres.

9. Greenhouse

The major activities at the proposed NEBP that will release greenhouse gases are due to indirect and direct sources such as fuel use in the vehicles during construction phase and operation of the NEBP and electricity usage.

9.1 Background to greenhouse gases

Greenhouse gases such as carbon dioxide have been implicated in gradual global climatic changes as they affect the balance between incoming solar energy and losses due to radiation from the earth and atmosphere. Australia is committed to monitor and report greenhouse gas emissions and has set a target level for emissions in 2010 to be no more than 8% higher than the emissions for 1990.

Pollutants of importance to global warming are water vapour (H_2O), nitrous oxide (N_2O), carbon dioxide (CO_2) and methane (CH_4). Indirect greenhouse gases such as carbon monoxide (CO), nitrogen oxides other than N_2O and non-methane volatile organic compounds (NMVOCs) do not have a strong radiative forcing effect in themselves, but influence atmospheric concentrations of the direct greenhouse gases.

Water vapour is the major contributor to the greenhouse effect but is not normally considered because fluxes are dominated by the day-to-day precipitation cycle. Carbon dioxide is the next most significant greenhouse gas and the major anthropogenic contributor.

The relative importance of a greenhouse gas is measured in terms of its global warming potential (GWP), usually related to a GWP of 1 for carbon dioxide. Nitrous oxide and carbon dioxide are greenhouse gases that are associated with combustion activities, such as occur in diesel fuelled vehicles and the combustion of fossil fuels to generate electricity. Carbon dioxide tends to remain active for a lifetime of around 150 years and has a GWP of 1 on a 100 year time frame. Nitrous oxide has a lifetime of 120 years and a GWP of 310 on a 100 year time frame. Methane has a lifetime of 14.5 years and a GWP of 21 on a 100 year time frame. Whilst nitrous oxide and methane have a greater potential to cause global warming, carbon dioxide is produced in far greater quantities by anthropogenic activities than nitrous oxide and methane and consequently, carbon dioxide is the most important greenhouse gas.

Greenhouse gas emissions are reported in terms of tonnes of carbon dioxide equivalent ($tCO_{2\text{-}e}$). Carbon dioxide equivalents are calculated as the sum of the emission rate of each greenhouse gas multiplied by the global warming potential.

As follows: $tCO_{2\text{-}e}$ = tonnes CO_2 x 1.0 + tonnes CH_4 x 21 + tonnes N_2O x 310.

9.2 Greenhouse Challenge Plus and emissions estimation

The Greenhouse Challenge Plus programme is part of the Federal Government's climate change strategy and is managed by the Australian Greenhouse Office (AGO). The Greenhouse Challenge Plus programme is designed to:

- Reduce greenhouse gas emissions;
- Accelerate the uptake of energy efficiency;
- Integrate greenhouse gas issues into business decision making; and
- Provide more consistent reporting of greenhouse gas emission levels.

The AGO is a part of the Department of the Environment and Heritage. The AGO monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. The AGO has published greenhouse gas emission factors for a range of anthropogenic activities. The AGO methodology for calculating greenhouse gas emissions is published in the AGO Factors and Methods Workbook (AGO, 2005) and is based on Australian data. This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The AGO Workbook defines three scopes of emission categories for calculating greenhouse gas emissions. These are as follows:

- Scope 1: This covers the direct emission sources within the boundary of an organisation such as the emissions from fuel combustion of vehicles.
- Scope 2: This covers indirect emissions from consuming purchased electricity, steam or heat that is produced by another organisation.
- Scope 3: This covers all other indirect emissions from sources that are not owned or controlled by an organisation but occur as a consequence of the organisations activities.

Scope 1, Scope 2 and some Scope 3 emissions are commonly reported. Scope 3 emissions that are usually reported include emissions from off-site waste disposal, emissions associated with production of fuels and emissions from transmission, distribution and generation of electricity.

9.3 Greenhouse gas producing activities and emission factors

The major activities for the proposed NEBP that produce greenhouse gas emissions are:

- Scope 1: petrol, diesel and fuel oil combustion in vehicular and marine traffic.
- Scope 2: electricity consumption.
- Scope 3: production, transport and distribution of fuel and electricity.

Table 9 summarises the greenhouse gas emission factors used to quantify greenhouse gas emissions from the proposed NEBP.

Table 9: Greenhouse gas emission factors (AGO, 2006)

Activity/ source	Units	Scope 1	Scope 2	Scope 3	Full fuel cycle
Petrol combustion	t CO_{2-e} / kL	2.4	-	0.3	2.6
Diesel combustion	t CO_{2-e} / kL	2.7	-	0.3	3.0
Electricity consumption	kg CO_{2-e} /GJ	-	251	40	291

9.4 Greenhouse gas emissions

9.4.1 Construction

The greenhouse gas emission due to construction activities has been calculated. The fuel consumption was estimated using a fuel efficiency of 0.546 L/km for haul vehicles. Fuel consumption related to other diesel vehicles such as bulldozers, excavators and compactors are not known at this stage but have been assumed to be equivalent to 25% of the haul trucks as these are the main fuel consumers. The emissions (Table 10) were calculated on the following assumptions:

- Haul trucks travelled at total of 100,000 kilometres per year; and
- Other vehicles travelled a total of 30,000 kilometres per year.

It is expected that 0.0002 Mt CO_{2-e} greenhouse gas emissions will be generated per year of construction of the NEBP.

Table 10: Greenhouse gas emissions during construction of NEBP

Activity/ source	Units	Scope 1	Scope 2	Scope 3	Full fuel cycle
Haul	t CO_{2-e}	147	-	16	164
Excavators/compactors	t CO_{2-e}	55	-	6	61
Total					**225**

9.4.2 Traffic accessing the NEBP

The greenhouse gas emissions due to vehicular traffic accessing the Business Park, residential areas and the marina precinct have been calculated. The emissions were calculated using the following assumptions:

- Business Park
  - The number of vehicles accessing the Business Park per day is 26,460;
  - The percentage of vehicles that are commercial/heavy vehicles is 10%;
  - The Business Park operates 6 days per week, 52 weeks per year;
  - Distance travelled from Bruce Highway off-ramp to Business Park and back is 6.1 kilometres; and
  - Fuel efficiencies of a passenger car and a heavy vehicle are 0.113 L/km and 0.546 L/km respectively (AGO, 2006).
- Residential and Marina Precinct
  - The number of vehicles access the areas is 11,461;
  - The percentage of vehicles that are commercial/heavy vehicles is 0%;

- Distance traveled from Bruce Highway off-ramp to residential area and marina and back is 16 kilometres; and
- Fuel efficiency of a passenger car is 0.113 L/km.

It is expected that 0.042 Mt CO_{2-e} greenhouse gas emissions will be generated per year due to traffic accessing the NEBP.

Table 11: Greenhouse gas emissions during operation of NEBP

Activity/ source	Units	Scope 1	Scope 2	Scope 3	Full fuel cycle
Business Park	t CO_{2-e}	19,946	-	2,389	21,817
Residential Area	t CO_{2-e}	15,461	-	1,933	16,750
Marina Precinct	t CO_{2-e}	2,768	-	346	2,998
Total					**41,565**

10. Conclusions and recommendations

- During construction it is essential that good dust control and management is implemented to ensure that the potential for dust nuisance is minimsed. A dust management plan should be implemented for the construction phases.

- Existing air quality at the NEBP site is likely to be within ambient air quality standards and, therefore, does not provide a major constraint for development.

- The air conditioning intakes on buildings should be located where truck movement or idling engine emissions cannot adversely affect the indoor air quality. A separation distance of at least 20 metres is recommended from internal roadways to buildings.

- In addition air conditioning intakes should be located away from the proposed Marine industry precinct to avoid potential odour nuisance.

- New industries should be designed and operated to ensure compliance with air quality standards and to minimise air pollutants to the maximum extent that is economically feasible. Current air pollution regulations such as the NSW Clean Air Regulation provide guidance on this.

- Industries with particular requirements for low air pollution (such as food storage, food manufacturing or pharmaceutical manufacturing facilities) should not be located close to the proposed transport corridor or Marine Industry Precinct.

- Potential businesses such as small goods and warehousing, that will not produce significant quantities of air pollutants, should not need to individually assess their air emissions.

- Notwithstanding the above, there may be a requirement for detailed air quality assessments for proposals that are subject to integrated development assessment processes and permits of Council and the Environment Protection Agency.

11. References

ANZAC and NH&MRC (1985), “National guidelines for control of emissions of air pollutants from new stationary sources.”

Australian/New Zealand Standard (2001), “Stationary source emissions Part 3: Determination of odour concentration by dynamic olfactometry”, AS/NZS 4323.3:2001.

National Environment Protection Council (1998), "National Environmental Protection Measure for Ambient Air Quality". National Environmental Protection Council.

National Environmental Protection Council (NEPM), (December 2004), “National Environment Protection (Air Toxics) Measure”.

National Health and Medical Research Council (NH&MRC), (1985), “National Guidelines for control of emissions of air pollutants from new stationary sources”.

New South Wales Government No Dust No Fuss Booklet - Guidelines for Controlling Dust from Construction Sites and No Dust No Fuss Factsheets (http://www.parracity.nsw.gov.au/publications/

New South Wales Environment Protection Agency. 2001, “Draft policy: assessment and management of odour from stationary sources in New South Wales”.

NSW DEC (2002), “Protection of the Environment Operations (Clean Air) Regulation 2002 (includes Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005.

New South Wales DEC (2005), “Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales” .

National Pollution Index (NPI) (2004) www.npi.gov.au

Queensland Environmental Protection Act (1994), Reprinted as in force on 6th June 1996 (includes amendments up to Act No. 10 of 1996).

SEPP(AQM) 2001, “State Environment Protection Policy (Air Quality Management) Environment Protection Act 1970.” Victoria Government Gazette, Special No. S 240 Friday 21 December 2001. Victorian Government Printer.

USEPA (1995) - AP42, Fifth Edition, Volume 1: Stationary Point and Area Sources: Chapter 13.2.2 “Unpaved Roads” (2006 draft).

USEPA (October 1998). Chapter 11.9.1 “Western Surface Coal Mining”, AP-42. USEPA Office of Air Quality Planning and Standards.

VICTORIAN EPA (1990), “Recommended buffer distances for industrial residual air emissions”. Publication No. AQ 2/86 (Revised July 1990).

Figure 1: Site layout of the proposed Northeast Business Park at Caboolture

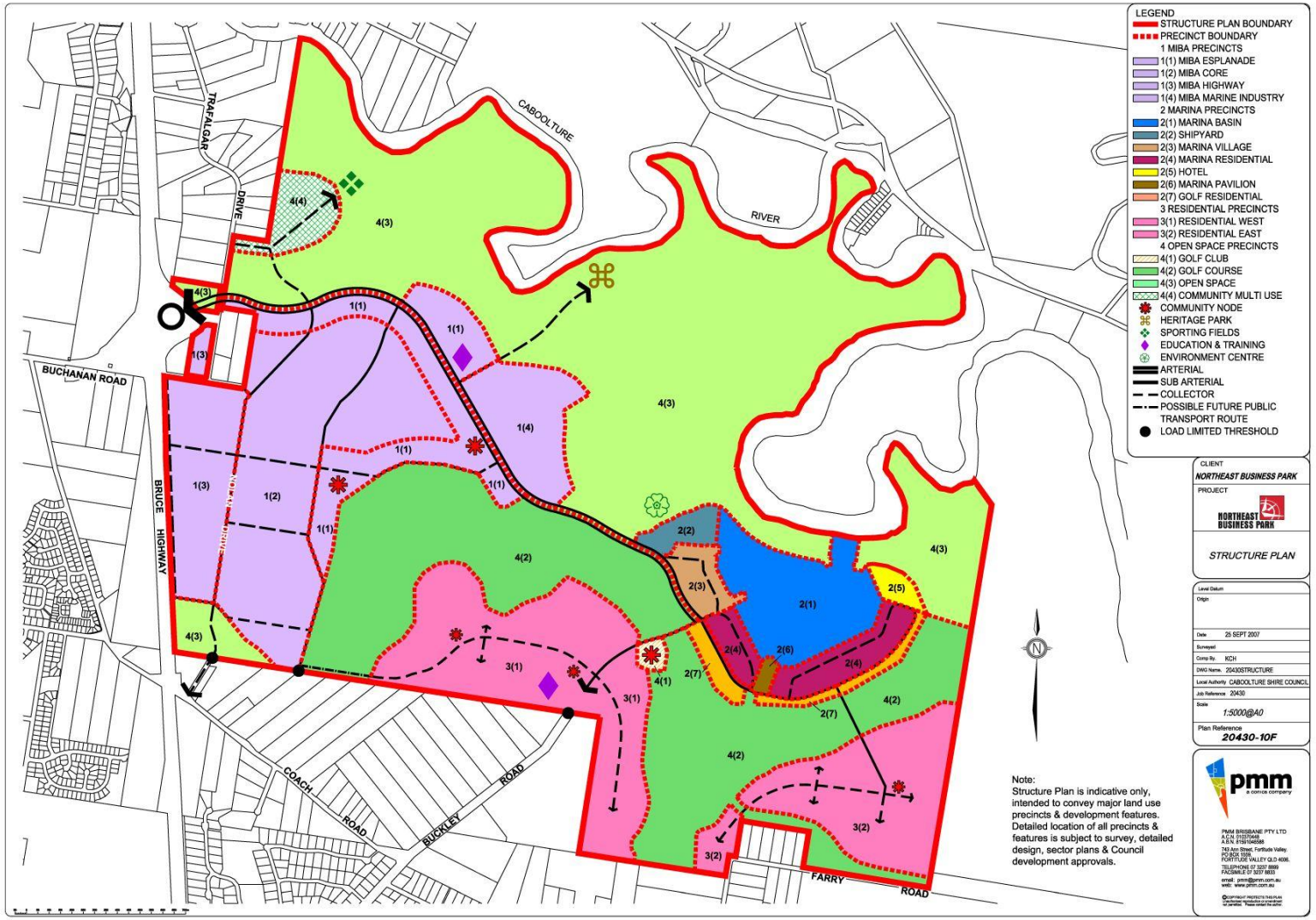


Figure 2: Monthly average maximum, minimum and mean temperature, Brisbane Airport, for the period from 1994 to 2007

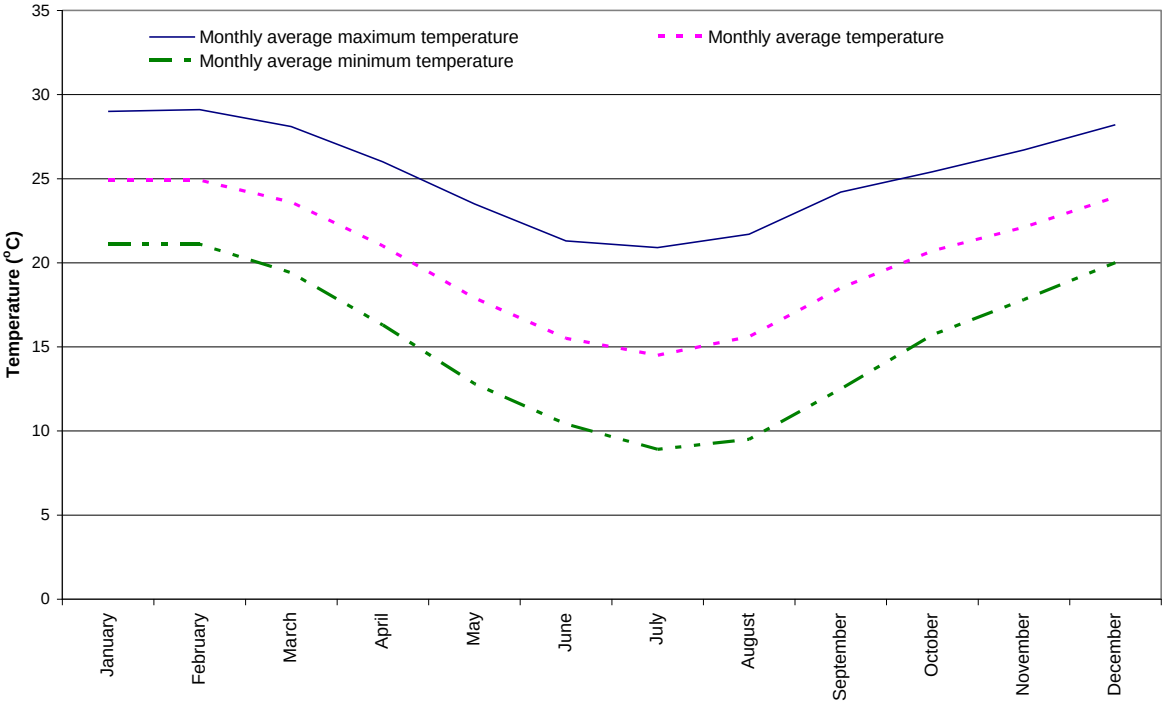


Figure 3: Windrose for the Brisbane Airport (BOM) monitoring site, for the period July 1994 to May 2007, all hours

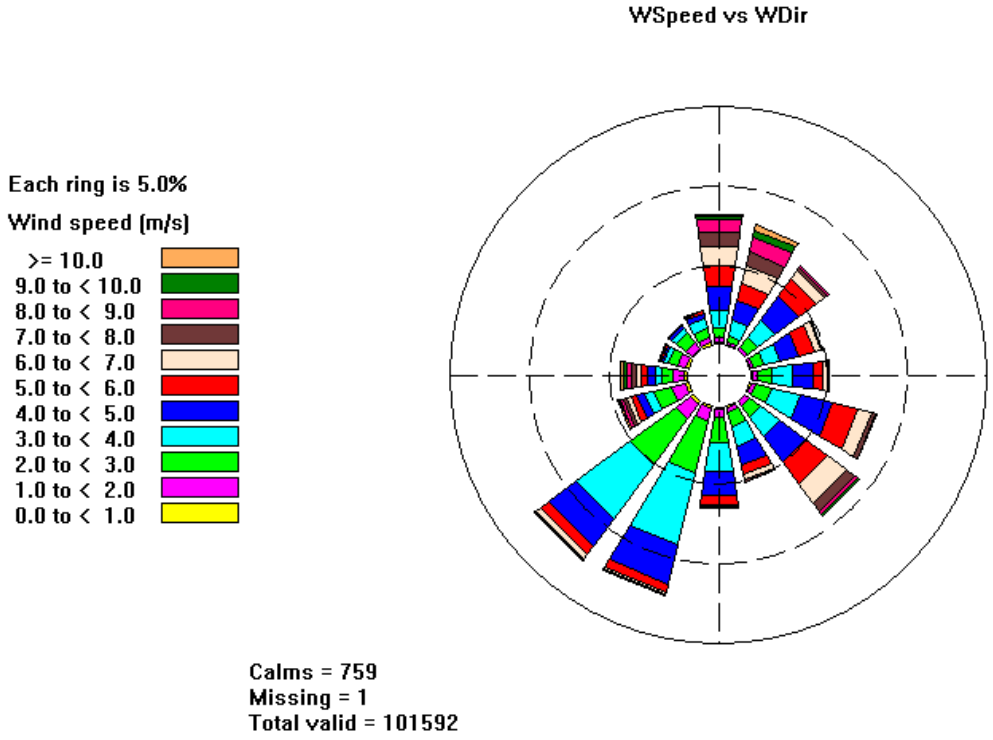


Figure 4: Windrose for the Deception Bay (EPA) monitoring site, for the period January 1995 to August 2005, all hours

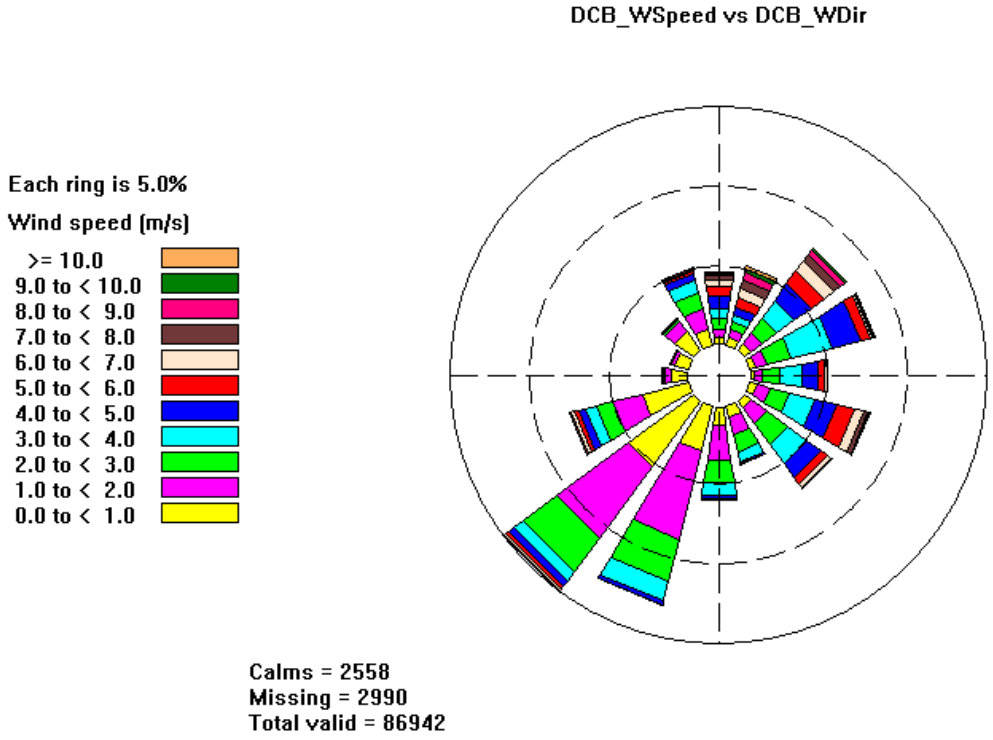


Figure 5: Windrose for the Brisbane Airport (BOM) monitoring site, for the period July 1994 to May 2007, based on time of day.

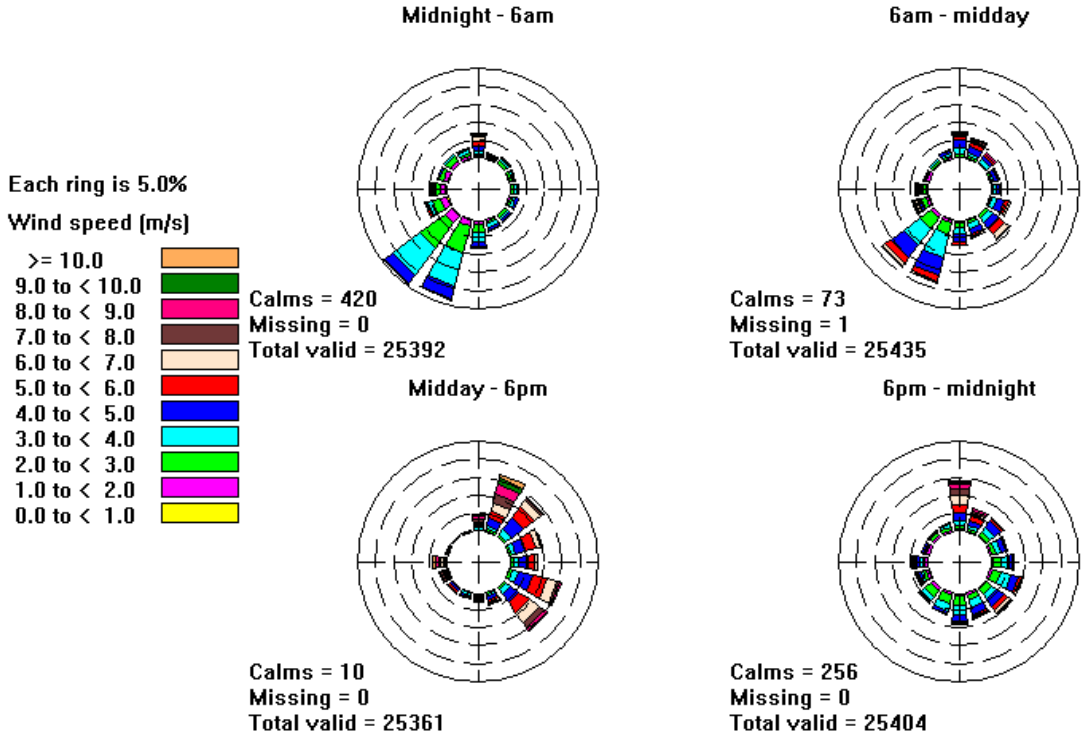


Figure 6: Windrose for the Deception Bay (EPA) monitoring site, for the period January 1995 to August 2005, based on time of day.

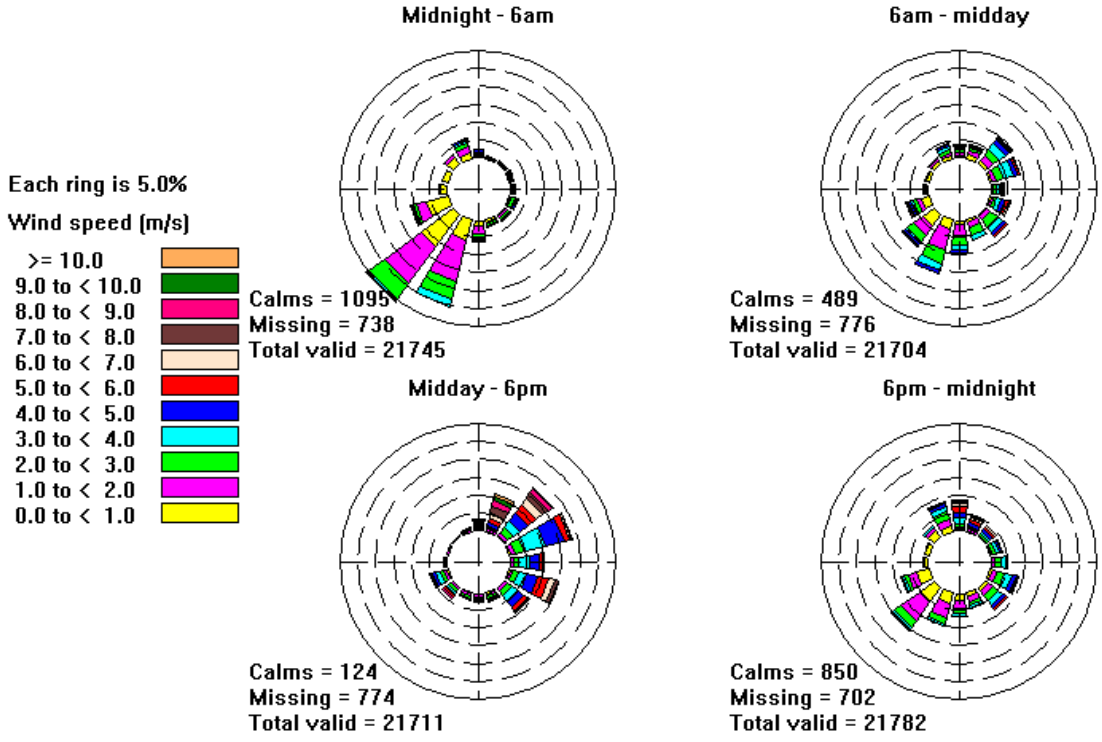


Figure 7: Windrose for the Brisbane Airport (BOM) monitoring site, for the period July 1994 to May 2007, based on season

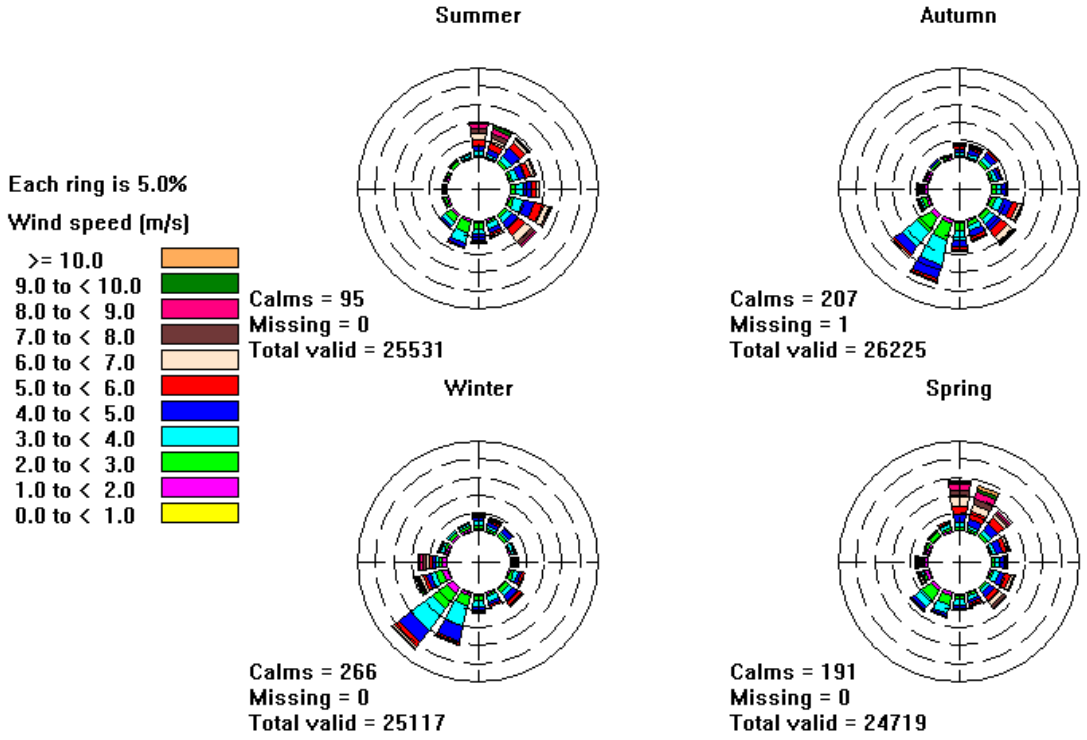


Figure 8: Windrose for the Deception Bay (EPA) monitoring site, for the period January 1995 to August 2005, based on season

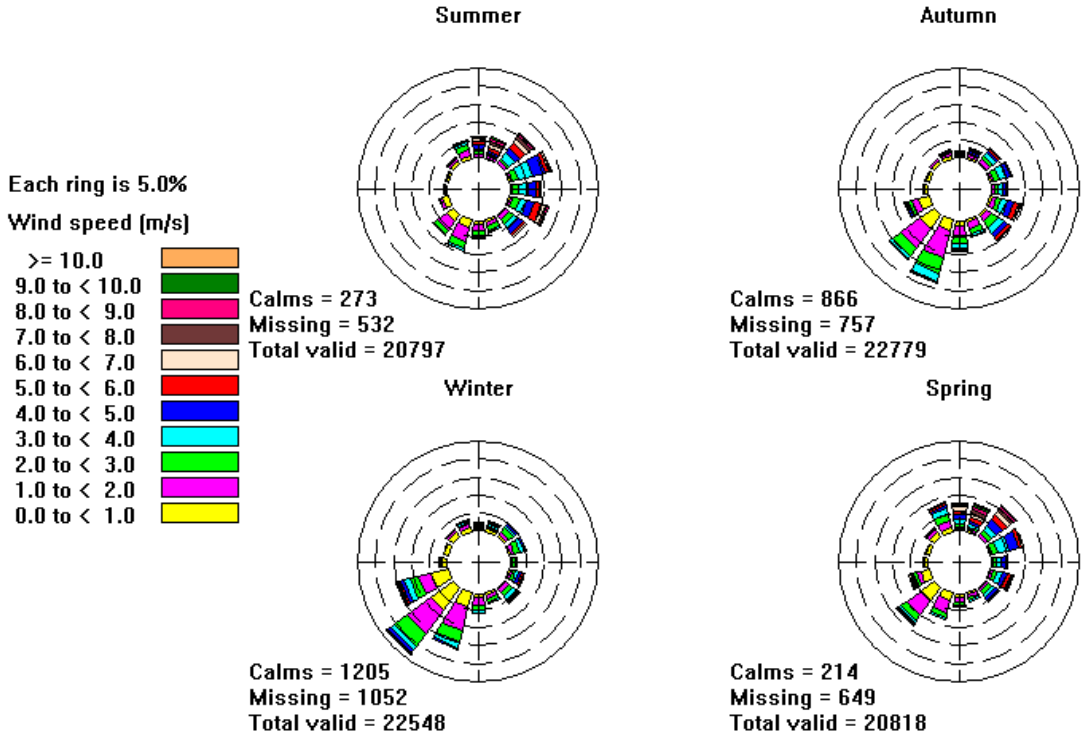
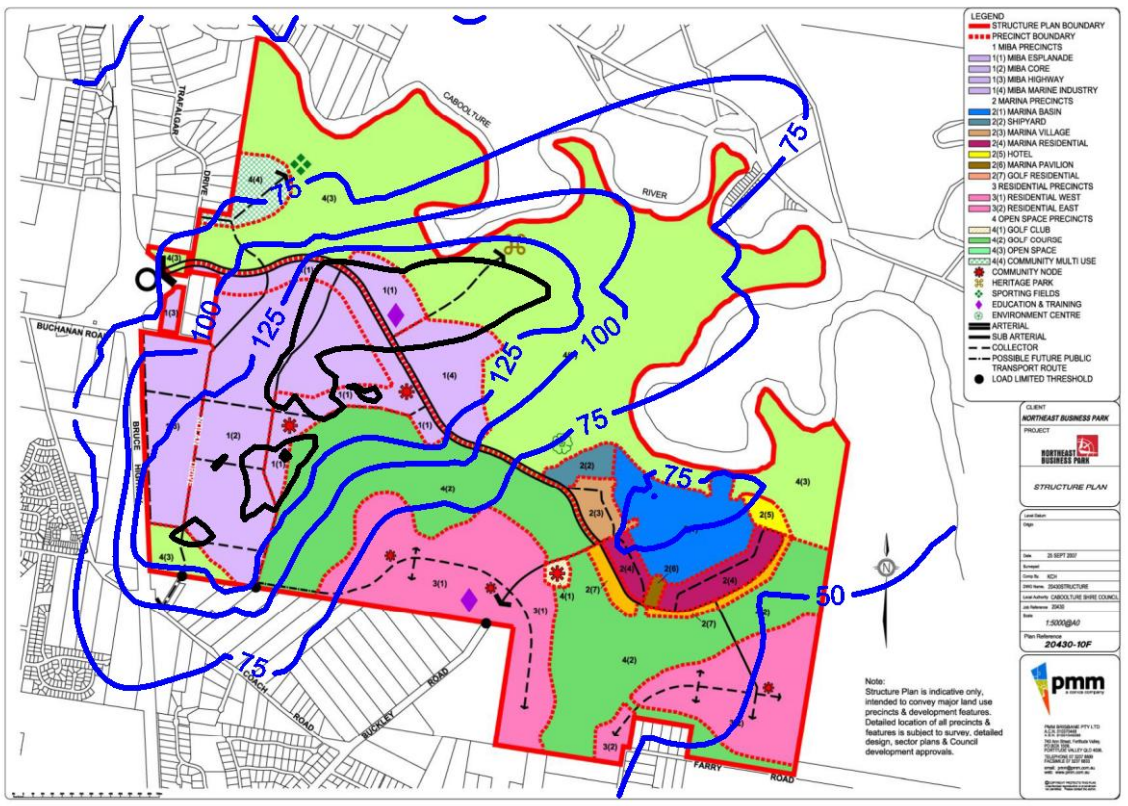
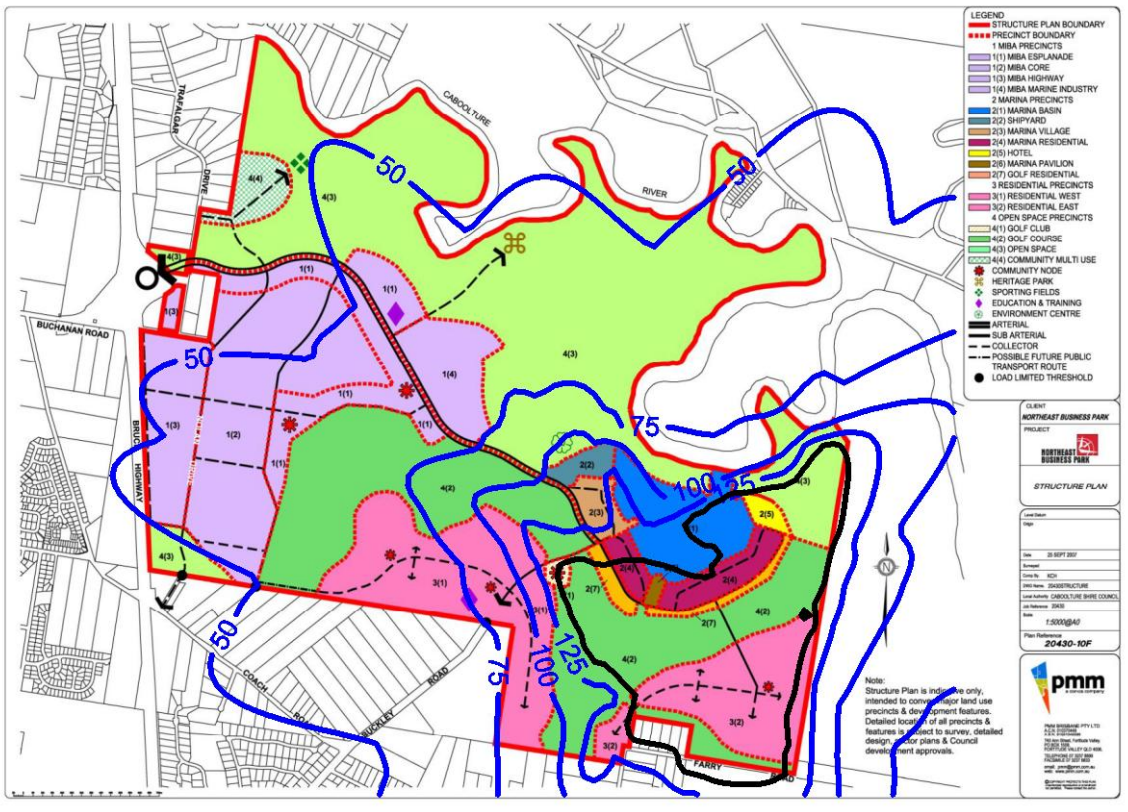


Figure 9: Predicted maximum 24-hour average ground-level concentrations of PM_{10} due to (a) phase 1, (b) phase 2 and (c) phase 3 of construction of the Northeast Business Park, Caboolture, including a background of 30 μg/m^3. Contours in μg/m^3.

(a) Phase 1



(b) Phase 2



(c) Phase 3

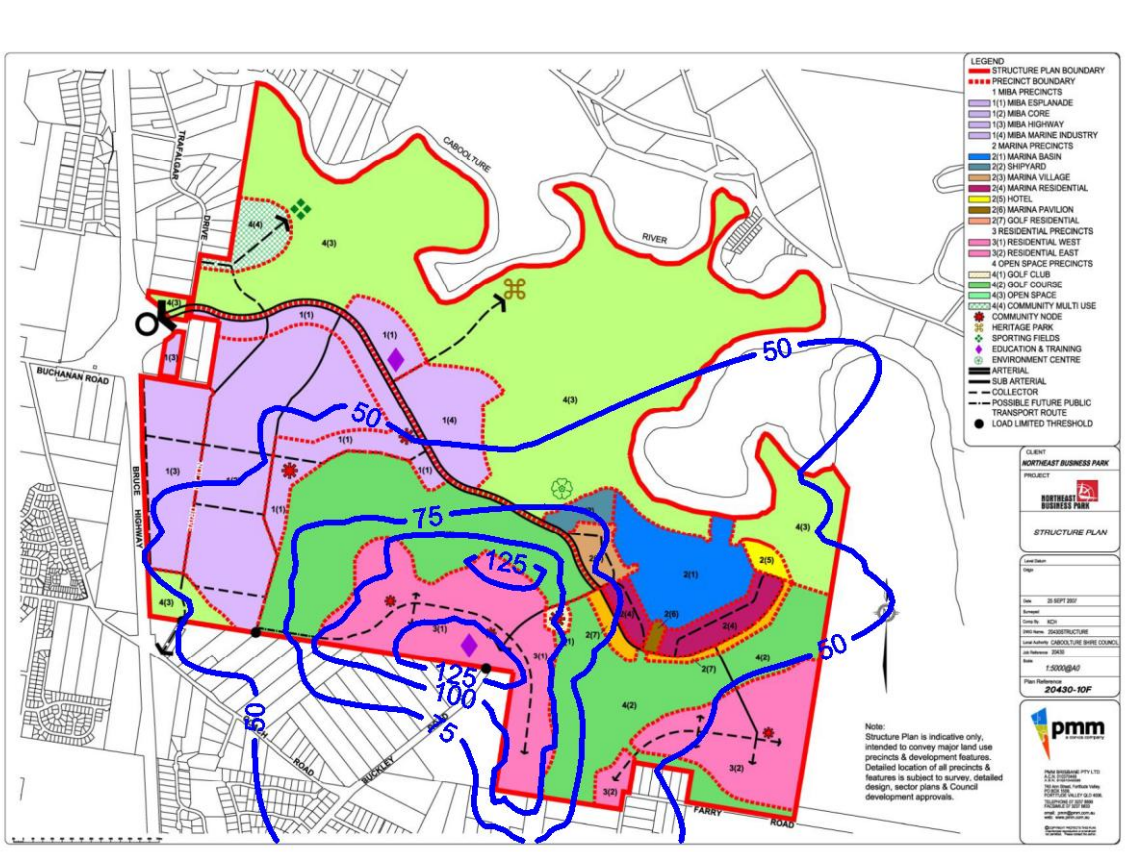
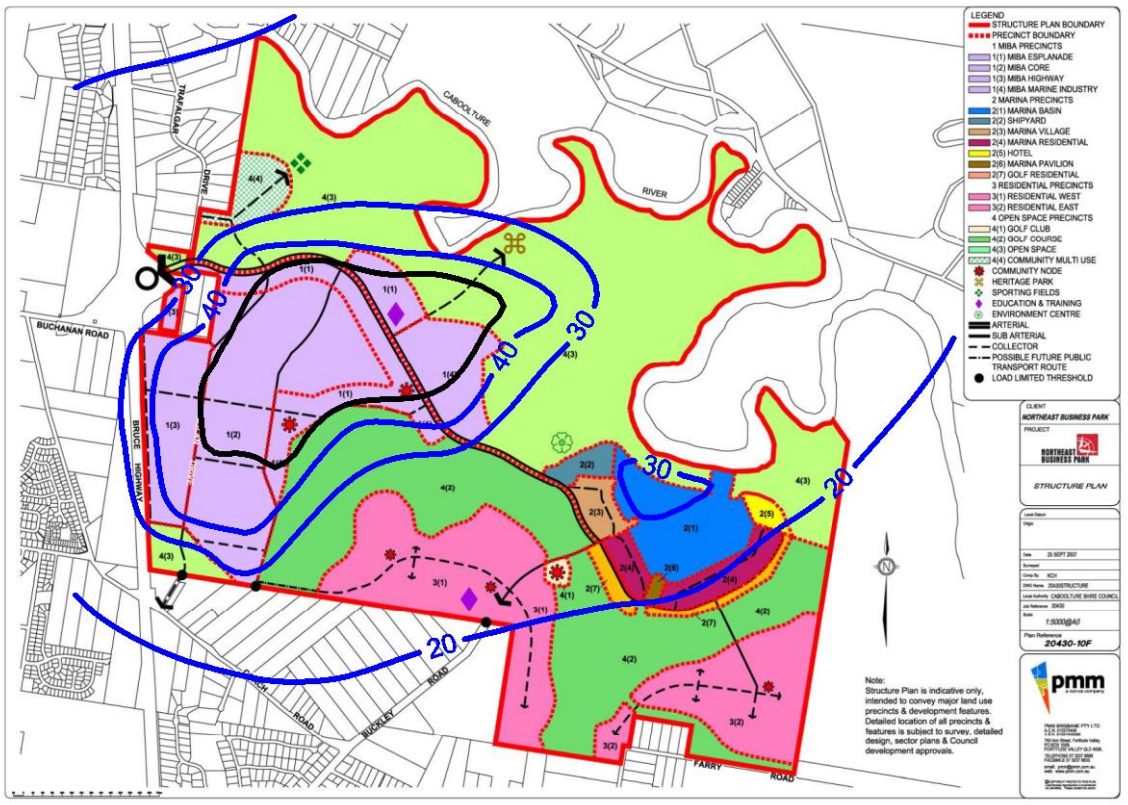
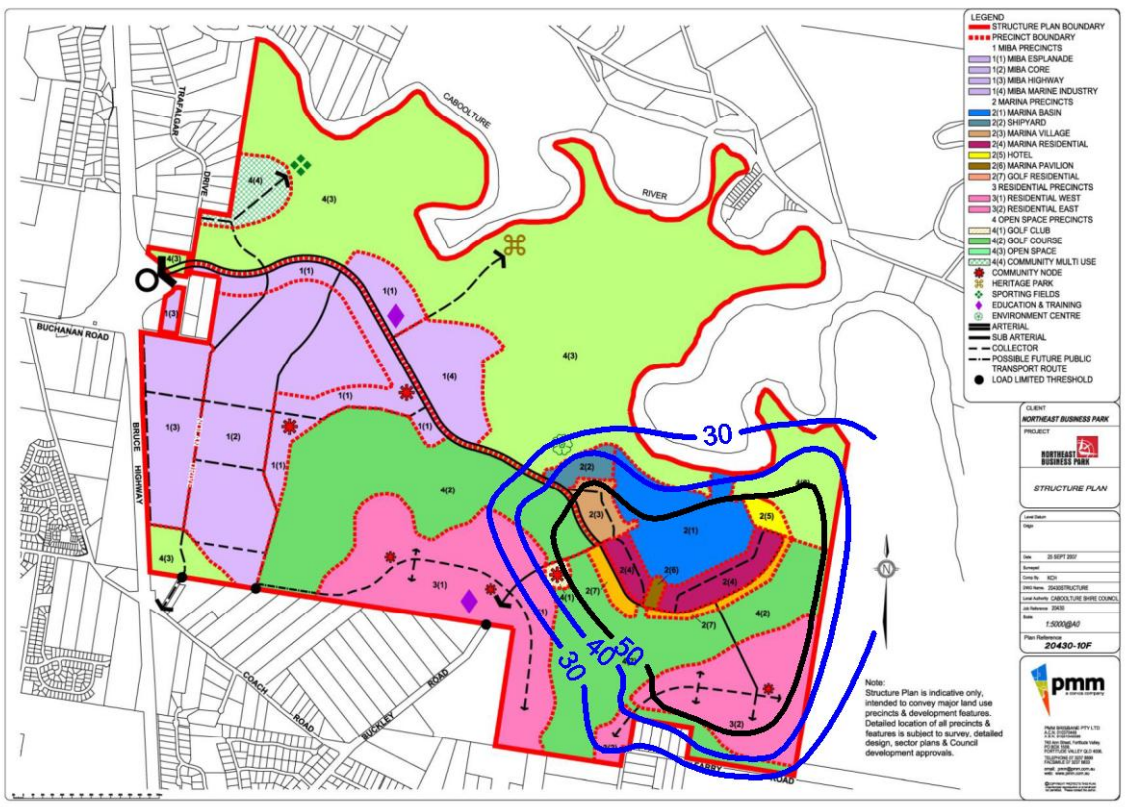


Figure 10: Predicted annual average ground-level concentrations of PM_{10} due to (a) phase 1, (b) phase 2 and (c) phase 3 of construction of the Northeast Business Park, Caboolture, including a background of 17 μg/m^3. Contours in μg/m^3. EPP(Air) goal of 50 μg/m^3 denoted by black line.

(a) Phase 1



(b) Phase 2



(c) Phase 3

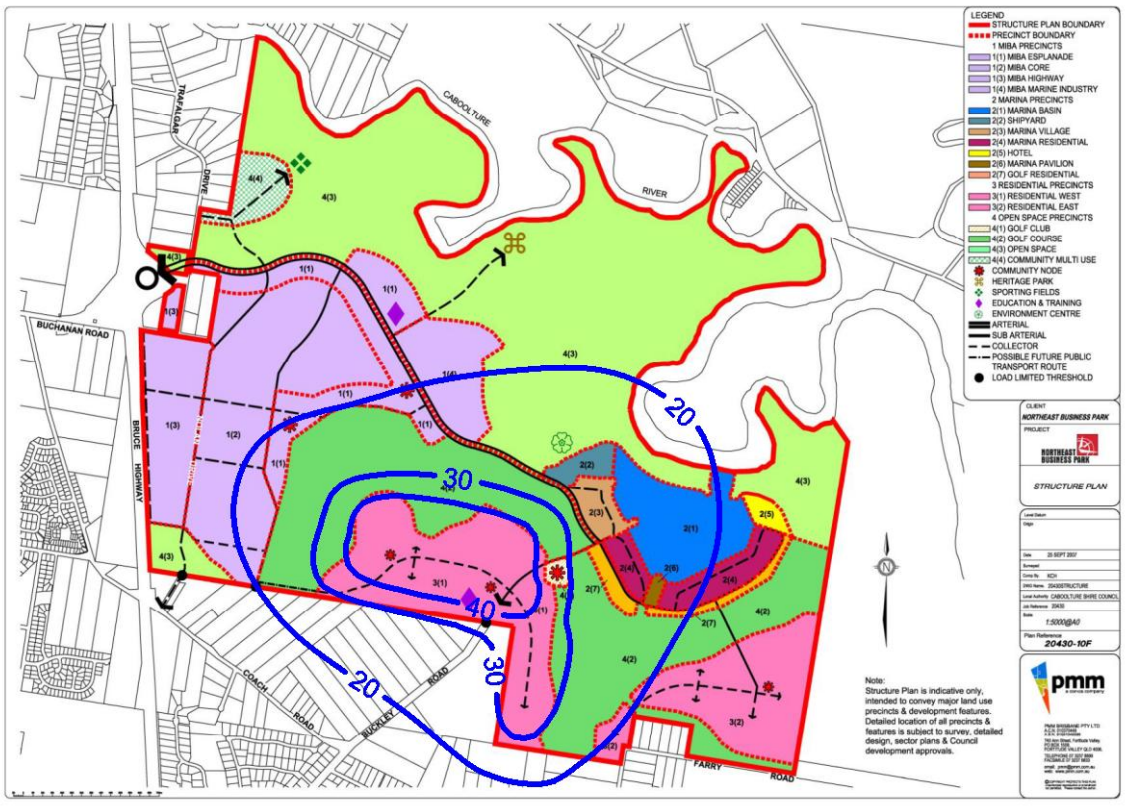


Figure 11: Predicted annual average ground-level concentrations of TSP due to (a) phase 1, (b) phase 2 and (c) phase 3 of construction of the Northeast Business Park, Caboolture, including a background of 24.2 μg/m^3. Contours in μg/m^3. EPP(Air) goal of 90 μg/m^3 denoted by black line.

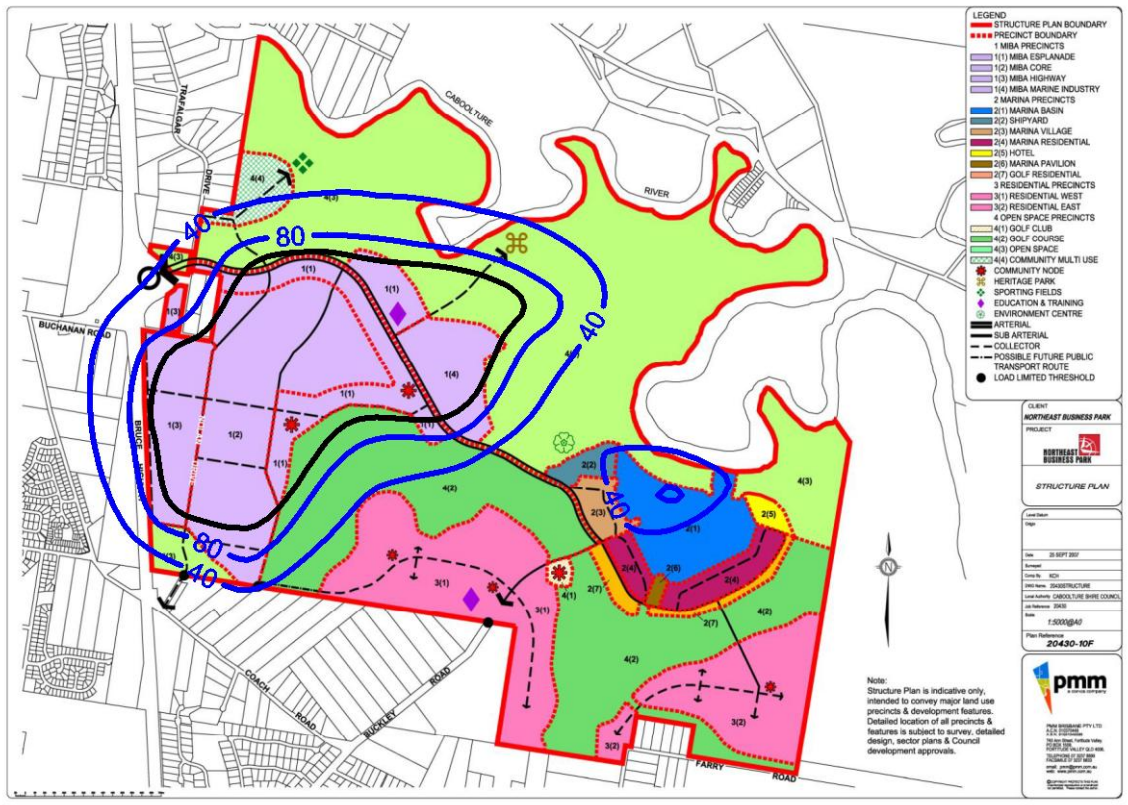
(a) Phase 1

(b) Phase 2

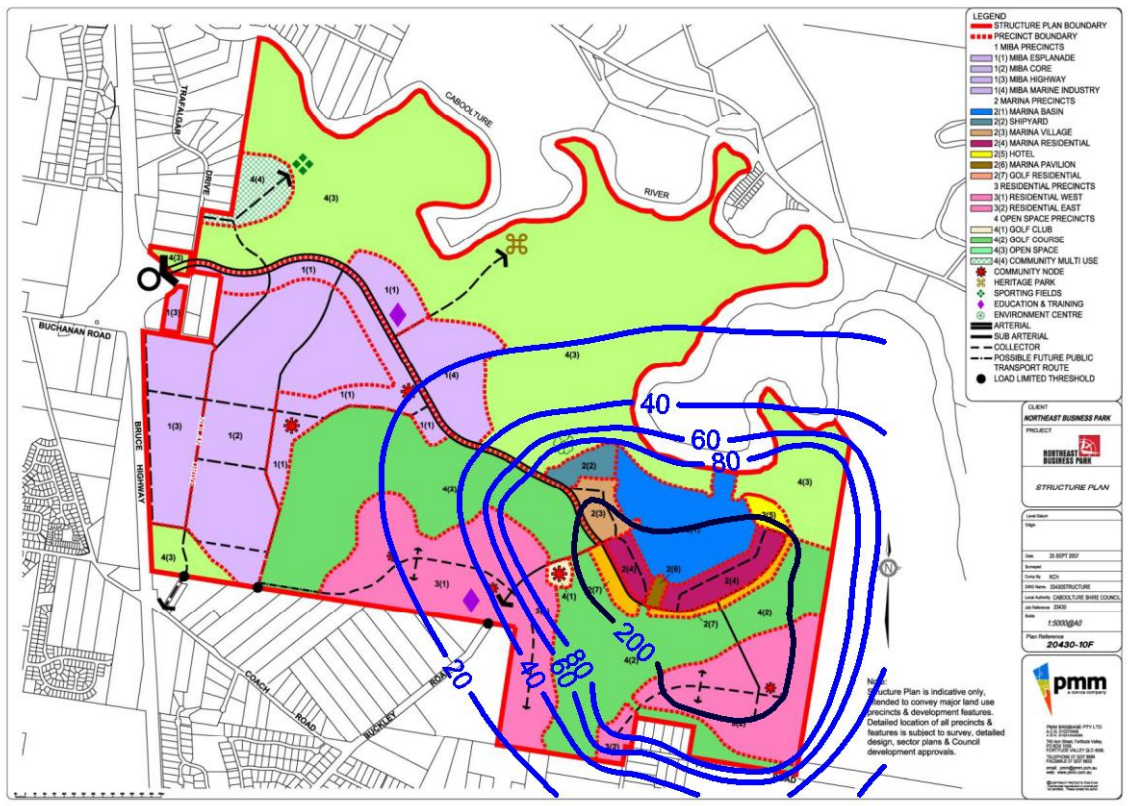
(c) Phase 3

Figure 12: Predicted annual average dust deposition rate due to (a) phase 1, (b) phase 2 and (c) phase 3 of construction of the Northeast Business Park, Caboolture, including a background of 20 mg/m^2/day. Contours in mg/m^2/day. Recommended EPA guideline of 120 mg/m^2/day denoted by black line.

(a) Phase 1



(b) Phase 2



(c) Phase 3

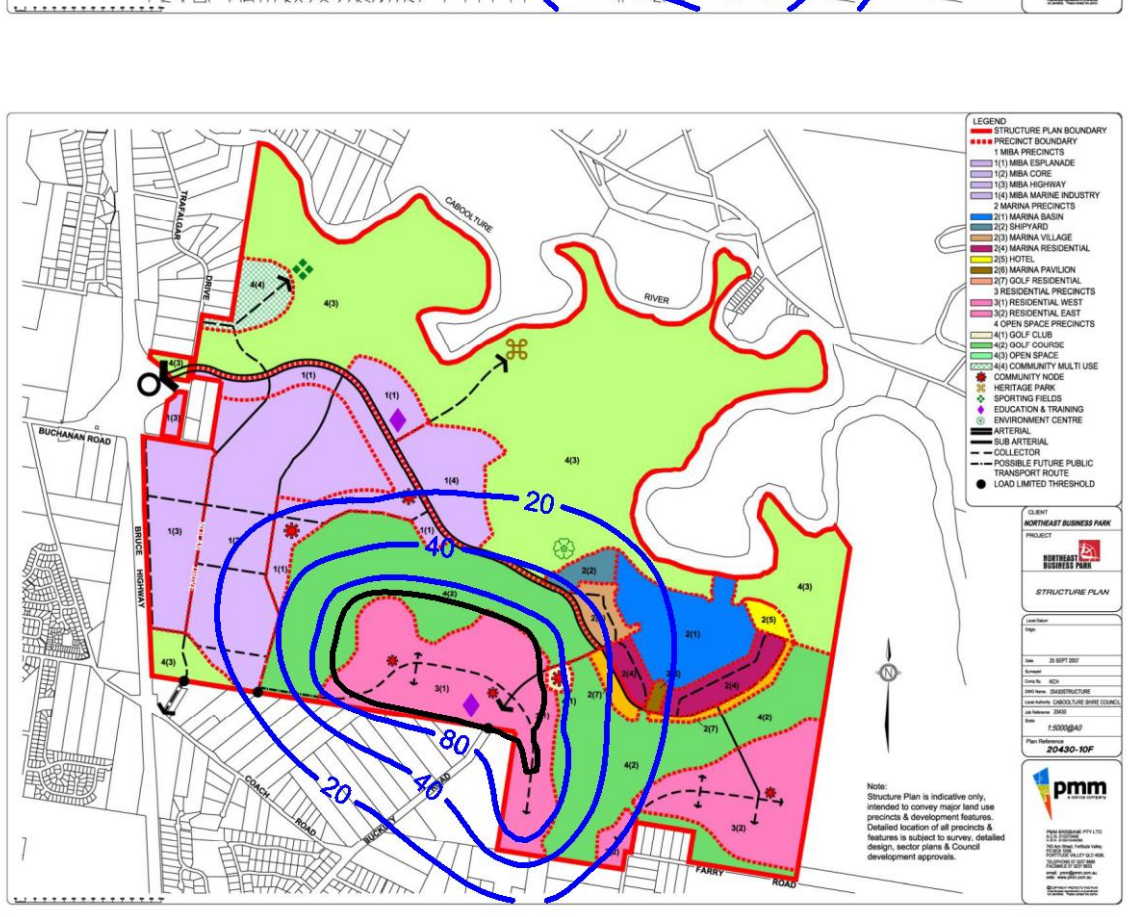


Figure 13: Diurnal traffic profile