Attachment B – Revised Air Quality Impact Assessment Report dated 10 September 2010

Port Kembla Port Corporation
10 September 2010

Air Quality Impact Assessment

Port Kembla Outer Harbour Development

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Air Quality Impact Assessment

Port Kembla Outer Harbour Development

Prepared for

Port Kembla Port Corporation

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Port Kembla Port Corporation (PKPC) to undertake an air quality impact assessment (AQIA) for the Port Kembla Outer Harbour Development (PKOHD). The purpose of the investigation was to identify and analyse key air quality issues relating to the proposed development including Concept Plan application and the Major Project application (Stage 1) of the Concept Plan.

The AQIA examines the likely sources of air pollution during both construction and operational phases of the project, and investigates the local and regional air quality characteristics to determine the capacity of the local airshed to absorb emissions from the proposed development.

Air dispersion modelling was undertaken to predict the likely air quality impacts that the project may have on the surrounding area. The Concept Plan has the potential to result in long term impacts related primarily to moored ships and increased vehicle movements (trains and trucks), whilst the Major Project is likely to result in short term impacts related primarily to material haulage and stockpiling of fill material during construction and long term impacts during operation from moored ships and increased vehicle movements (trains and trucks). The modelling has been undertaken using the predicted 'peak operating capacity' (worst case operations) for the development

The Director-Generals Requirements (DGRs) provided by the NSW Department of Planning (DoP) (DoP reference S08/00337-1) dated 27 January 2009 lists Air Quality as a key issue to address. The DGRs provided that the Environmental Assessment (EA) must assess air pollutants, including dust and any other atmospheric pollutants of concern for "*local regional and inter-regional air quality, from fugitive and point sources, taking into account of the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"* (DEC, 2005). In particular, the EA must assess the "*potential odour from dredge spoil and proposed odour control*".

In addition to the DGRs, an adequacy review by DoP (dated 2 November 2009) of the draft EA submitted on 1 October 2009 was undertaken. In regards to air quality issues, the review required the AQIA to expand its description and quantified assessment of the "*operation of dredging equipment and material haulage during reclamation activities*" as well as potential impacts from operations of the terminals and increased vehicle traffic. In a subsequent teleconference with DoP staff (held on 24 November 2009) an appropriate quantitative approach and modelling methodology was formulated to meet the requirements of the DGRs and adequacy review.

1.1 Scope of Work

A summary of the scope of works formulated in consultation with DoP and DECCW is as follows:

- Ambient background pollutant concentrations were investigated for the area surrounding the Outer Harbour development. These levels were analysed to determine the capacity of the local airshed to absorb increased emissions whilst still complying with regulatory limits;
- Local topography, meteorology and location of sensitive receptors (both now and potentially in the future) were examined to assess how these factors may affect the development pollution envelope;
- The potential for odour emission from dredging operations was considered; and
- Quantitative air dispersion modelling was undertaken to predict the likely air quality impacts that the Concept Plan application and Major Project application (construction and operation) may have on the surrounding area. The assessment incorporated increased traffic emissions from trains, trucks and shipping vessels, emissions from dredging vessels, and bulk material handling including stockpile emissions. The modelling results were combined with ambient pollutant concentrations (where available) and compared to NSW DECC assessment criteria.

1.2 Response to Regulatory Comments

This report is a revision of the AQIA placed on public exhibition and dated 11 February 2010. The report has been revised to address written comments received from the Department of Environment Climate Change and Water (DECCW) dated 7 May and 16 July, 2010 and from the Department of Planning (DoP) dated 10 August, 2010. A meeting was also held with DECCW on 29 July, 2010 to discuss and clarify a number of the specific issues raised.

In addressing the issues raised a number of the underlying assumptions and methodologies were revisited, in particular those relating to ship and train movements, to refine the input information to the model to better reflect operational characteristics and to correct some inconsistencies noted in the original emissions inventory.

The modifications made to the emissions inventory are summarised below and discussed in more detail in **Appendix B** of this report:

- The throughput volume of stockpile areas was reduced to exclude materials that are not stockpiled or stored in enclosed areas
- Allowing for the density of fill material to allow for conversion of fill volume to fill tonnage
- Averaging total construction fill over the 8 year construction period
- Revising the number of trains per day for both the Major Project construction and operation phases
- Modelling of train emissions as stack rather than volume sources while trains are stationary or moving slowly in the South Yard
- Refining train throttle levels and times based on updated information available from the consultant undertaking the Rail Masterplan;
- Applying ship emission rates to each individual berth in the Concept Plan
- Adjusting expected truck numbers per year during the construction to accurately reflect the traffic report
- Applying the correct SO_2 emission factor for ship auxiliary power engines

Finally, as requested by DoP, the report has been revised to include an assessment of a normal operations scenario for the Concept Plan in addition to a worst case or peak operations scenario as had already been modelled. The details of the predicted air quality impacts associated with a normal operations scenario for the Concept Plan are provided in **Appendix C** of this report.

2.0 Assessment Background

2.1 Assessment Area

The PKOH is located in the Illawarra region of NSW, approximately 80km south of Sydney. Illawarra is the fourth largest major population centre of NSW and has the nation's ninth largest port. It is located on a thin coastal strip with a steep escarpment approximately 8 km to the west of the port. The escarpment is a major influence on meteorology and air quality in the region. It can steer or deflect winds, changing the apparent direction at the surface. It can also lead to the decoupling of winds above and below the escarpment. As a result an inversion can form at the top of the escarpment, limiting the dispersion of pollutants in the Illawarra region.

Port Kembla is located approximately 5 km south of the Wollongong CBD. The port area encompasses coal and grain handling facilities, steel works, a fertiliser manufacturer and ship loading facilities. A railway line and main arterial road provide access to the port area. Residential premises are also located within 1 km of the port. Existing land use within the local area includes industrial, mixed commercial and residential.

The regional and local context of the development site is provided in **Figures F1** and **F2** respectively.

2.2 Project Description

2.2.1 Approval Framework

Port Kembla Port Corporation is seeking concurrent Concept Plan approval for the total development and Major Project approval for Stage 1 of the development. The Major Project sits within, and is part of, the overarching Concept Plan framework. A description of the Concept Plan and Major Project is provided below. Further discussion on the Concept Plan and Major Project is presented in Sections 5 and 6 of the Environmental Assessment report.

2.2.2 Concept Plan Description

The Outer Harbour development is to be constructed in three discrete stages over the next 30 years with an anticipated completion date of 2037. Concept Plan approval is being sought for the total development. Construction of the Concept Plan would be staged to meet the needs of prospective customers, to cater for growing port needs and regional development, and to increase the potential to address the needs of new industry for 30 plus years into the future.

The Concept Plan provides a framework for the progressive completion of the Outer Harbour development and comprises creation of land dedicated to port activity. The reclaimed land would be divided into two main areas, one devoted to the import and export of dry bulk, break bulk and bulk liquid cargoes (multi-purpose terminals) and one devoted to container trade (container terminals).

Once the Concept Plan is completed, the reclamation footprint of the development would extend from the existing Port Kembla Gateway Jetty in the north to Foreshore Road in the south, the boat harbour to the east and existing rail sidings to the west.

Physical features of the Concept Plan include the following:

- At least 42 hectares of hard stand, to accommodate new multi-purpose terminals and new container terminals
- Dredging would be completed over a series of dredging campaigns for:
  - Berth boxes and basins between multi-purpose terminals and container terminals.
  - Basins east of the container terminals.
  - Container berth boxes and approach channels.
- 1770 metres total new berth length.
- A total of seven new berths, including:
  - Four container berths with a total length of 1,150 metres.
  - Two multi-purpose berths designed to handle dry bulk, break bulk and bulk liquid with a total berth length of 620m.
  - A multi-purpose berth at the site of the existing No. 6 Jetty.

- Retention of the existing oil berth on the northern breakwater of the Outer Harbour.
- Berthing basins and approaches with up to -16.5 metres water depth below Port Kembla Harbour Datum for new berths.
- Road and rail infrastructure to support the expansion, including:
  - New road link from Christy Drive to the multi-purpose and container terminals.
  - Rail infrastructure upgrade in the South Yard.
  - A new road link connecting from Darcy Road to the car park of the recreational boat harbour.
  - An extension of existing rail sidings to connect to a rail siding on the container terminals.

PKPC is seeking Concept Plan Approval for the total development of the Outer Harbour with the understanding that separate Major Project applications would be made for approval to construct and operate facilities on the site. PKPC would construct the reclamation, road and rail infrastructure and basic services for the site as a whole. Development of specific facilities may be undertaken by PKPC or third party operators who would lease part of the site from PKPC for a specific purpose. It is initially intended that the first stage of the multi-purpose terminals, including utilities and amenities, would be developed, operated and maintained by PKPC as a common user facility.

Stage 1 would be constructed between 2010 and 2018, Stage 2 between 2014 and 2025 and Stage 3 between 2026 and 2037.

2.2.3 Major Project Description

Major Project Approval is being sought to construct and operate Stage 1 of the Concept Plan. Construction of the Major Project would be divided into three sub-stages, identified as Stage 1a, Stage 1b and Stage 1c. Construction elements of Stage 1 comprise demolition of No.3 and No.4 Jetties, and reclamation and dredging for the footprint of the total development, with the following exceptions which will form part of Stage 2 and 3:

- An area in the vicinity of the Port Kembla Gateway.
- Expansion of the current swing basin area (ship turning circle).

At the completion of Stage 1 the central portion of the multi-purpose terminals would be operational. Road and rail infrastructure to support the first multi-purpose berth would also be constructed, and would comprise:

- Upgrade of rail infrastructure in the South Yard.
- A new road link from Christy Drive to the central portion of the multi-purpose terminals.
- A temporary road to facilitate construction of the container terminals.

The Major Project application sits within, and is part of, the overarching Concept Plan. Stage 1 is proposed to be constructed between 2010 and 2018. Major Project Approval would allow PKPC to commence reclamation and dredging for the multi-purpose and container terminals and construct and commence operations for the first multi-purpose berth. Stages 2 and 3 of the Concept Plan would be subject to separate applications for Project Approval made at a later date.

2.3 Sensitive Receptor Location

Sensitive receptors are defined by the DECCW as "*a location where people are likely to work or reside*" and should "*consider the location of known or likely future sensitive receptors*" (DEC 2005). Land uses such as residential housing, schools, hospitals, nursing homes, and recreational areas are classified as sensitive receptors. **Figure F2** shows the local context of the PKOHD where industry and housing are located on the southern and western borders of the site. A more refined description of the sensitive receptors for the development is provided below:

- The nearest residences to the project area are located approximately 400m to the south west near the corner of Five Islands Road and Military Road, with other residences in a clockwise arc from south-south east to the west;
- Commercial and industrial areas are located on the boundary of the project area in all directions with the exception of adjacent water bodies;
- The nearest schools are Illawarra Senior College on Military Rd approximately 300m to the south west, Port Kembla Pre-School on Military Rd approximately 700m to the south and Port Kembla Public School on Gloucester Bvd approximately 1.2km to the south-south east;
- The nearest church is the Port Kembla Uniting Church located approximately 1km to the south west; and

- The nearest hospital is the Villa Maria Centre which is located approximately 6km to the west-north west, with the Illawarra Private Hospital and Victory Hospital located approximately 6.5km to the north west.

2.4 Potential Sources of Air Pollution from PKOHD

Potential sources of air pollution related to the construction and operational phases of the Concept Plan and Major Project applications are as follows:

2.4.1 General Construction

General construction operations (excluding dredging operations which are detailed later in this section) have the potential to increase short term pollution concentrations during the development. Pollutant emissions may increase due to the following operations:

- Earthworks (breaking soil); earthworks actively disturb the soil creating dust and the exposed soil is a source of windblown dust;
- Movement of vehicles over unsealed roads; vehicle movement over unsealed roads generates dust, while the road itself is a source of windblown dust;
- Raw material stockpiles; the stockpiling of raw materials required for construction needs (such as builders sand and blue metal) may increase the potential for dust caused when unloading and loading the stockpiles as well as wind generated dust from the stockpiles; and
- Emissions from vehicle engine combustion (discussed later in this section); increased vehicle pollution (such as oxides of nitrogen, carbon monoxide and particulates) from construction includes the use of earth moving machinery (bulldozers etc), haul trucks and increased worker vehicles.

It is understood that during the Major Project construction stage a material stockpile is to be present containing material required for reclamation activities and general construction. The reclamation material is sourced from off-site locations and may contain sand, stone, soil or blast furnace slag. The slag is well aged and effectively inert and as such it is assumed that it will not emit harmful vapours or other gaseous pollutants. Further discussion of potential release of heavy metals is provided in **Section 8.2**. The material will undergo a screening assessment prior to delivery on the site to ensure that the fill is suitably clean of pollutants such as heavy metals. Suitable mitigation measures should be employed to control the emission of pollutants from the stockpile. These have been discussed in **Section 8.0** and include watering of the stockpile or potentially covering it if not disturbed for large time periods.

It is assumed that 'Best Practice' pollution mitigation methods are employed at all times during construction to limit the potential impact on local air quality. It is envisaged that Major Project construction activities would be scheduled between the hours of 7 am and 6 pm Monday to Friday, and 8 am and 1 pm on Saturdays. This does not apply to dredging which will be applied 24 hours per day. Where practical, the nearest affected residents would be notified in advance of work proposed outside of these hours. Potential pollution from construction of the development will be short term and localised to the area surrounding the construction site and is not expected to have long term adverse impacts on the surrounding area.

Land reclamation has the potential to expose new unsealed dirt areas to winds, increasing the potential for dust emissions from these areas. Some of the material used for reclamation is likely to be wet sediment which limits dust emissions, with the reclamation areas sealed in the interim. It should also be noted that current areas of unsealed land that are prone to windblown dust impacts will be sealed for uses such as container storage, decreasing the potential emission of dust from these particular areas.

2.4.2 Dredge Spoil

During the Major Project construction period spoil will be dredged from selected areas of the harbour and used to fill areas that are to be reclaimed for the development. The spoil that will be dredged has the potential to emit odour and gaseous pollutants (such as hydrocarbons), with this potential increasing if dredge spoil is stockpiled above the water level. Information on the dredging operation and the potential air quality issues are discussed below.

Dredging Background

For Stage 1 (Major Project Application) a total of 4,628,049m^3 of fill will be required for the reclamation. Part of the fill will be sourced from dredging material from within the Outer Harbour (383,575m^3 rock and 833,675m^3 soft sediments) while the balance (3,410,799m^3) will need to be imported from external sources. A total of 798,398m^3 of blast furnace slag will be sourced from local stockpiles and 2,612,401m^3 will be sourced from other projects around the Sydney and Illawarra regions and transported to the site by rail and/or barge. A stockpile of off-site sourced reclamation material will be located within the as discussed in the previous section.

Some reclamation and dredging will be undertaken as part of subsequent stages of the development (Stage 2 and Stage 3). Approximately 50,000m^3 of material would be dredged from an area in the vicinity of the existing swing basin during Stage 3 to accommodate manoeuvring of vessels in and out of the proposed Outer Harbour berths once the eastern container terminals are operational. The material would be deposited in the reclamation for the eastern portion of the container terminals during Stage 3.

Material dredged from the Outer Harbour would be encapsulated and confined within a series of engineered containment structures, or bunds, at a lower harbour depth (approximately -10m Port Kembla height datum) beneath the proposed container terminal. Bund sizing and locations within the reclamation footprint would be determined as dredging and reclamation design activities progress.

Related Air Quality Issues

Environmental testing of sediments within the Outer Harbour found some sediments to be contaminated with heavy metals, Polycyclic Aromatic Hydrocarbons (PAH) and Tributyl Tin (TBT). It is proposed to permanently relocate the contaminated sediments from within the Outer Harbour dredging footprint to bunded containment areas which form part of the reclamation area, where they would be permanently contained and capped by clean fill. The contaminated soils will not be exposed to the atmosphere (they will remain within the water column) during the dredging process, therefore its movement will not result in the emission of pollutants to the atmosphere.

It has been identified that the dredging and filling process is to be conducted by methods designed to limit the exposure of the sediment to the atmosphere (including Cutter Suction Dredging, Backhoe Dredging or Grab Dredge) and does not involve any excavation or handling of dry sediments. For this reason the risk of dust, gaseous pollutants and odour emissions from the dredging activities is considered to be very low.

Any potential emission of dust, odour or gaseous pollutants from the dredge spoil is likely to occur during the construction phase only and any potential adverse impact will be short term and localised to the area surrounding the operation. Potential impacts will be managed by a Dredging Environmental Management Plan. In addition, recent dredging operations in the Inner and Outer Harbour have not resulted in odour complaints from the local community. As such, it is expected that the potential for nuisance odours to be emitted from the site due to dredging will be low.

2.4.3 Ship Loading

The PKOHD will involve the loading and unloading of bulk materials to and from ships, including the transfer of material from trains and trucks. As the primary use of the port facilities is for the transfer of bulk goods and containers, it is considered unlikely that such transfers will represent a potential pollutant source.

Auxiliary engines and boilers used during ship mooring are potential contributors to the local air quality. The engines and boilers from ships emit a number of pollutants including oxides of nitrogen, carbon monoxide, particulate matter (dust), sulphur dioxide and others. The content of pollutants from the moored ships auxiliary engine and boilers depends primarily on the power of the ship (kWh) and the type of fuel used (residual oil, marine diesel oil or marine gas oil).

The Concept Plan development will see an increase in moored ships in the Outer Harbour. It has been estimated that ships will be moored for an average of 14 hours per day for the bulk material berth (multi-purpose berth), 7 hours per day for the bulk cargo berths (multi-purpose berth) and 10 hours per day for the container berths.

2.4.4 Increased Vehicle Emissions

The construction and operation phase of the development will see an increase in vehicle traffic to the area leading to a potential increase in pollutants from fossil fuel combustion (likely to be diesel from both trucks and trains). Although the increase in vehicles during the construction phase has the potential to create increases in short term pollution concentrations, it is not expected to have long term adverse impacts on the surrounding area.

The increase in vehicle emissions due to the operational phase of the development has the potential to contribute to existing and long term pollutant levels in the surrounding area.

It is estimated that there will be approximately 184,714 trucks per year (assuming an average of 21 trucks per hour) serving the port during the Concept Plan stage. It is estimated that that there will be a maximum of approximately 71,760 trucks per year (expected in the first year of construction) serving the port over the Major Project (Stage 1) construction period, and 60,714 trucks per year (assuming an approximate average of 7 trucks per hour) serving the port during the Major Project operational period.

It is estimated that for the Major Project (Stage 1) construction period there will be 1 train per day unloading material in the construction stockpile area. During the Major Project operation period there will be an estimated 4 trains per day. During the Concept Plan operation period there will be an estimated 21 trains per day.

2.5 Pollutants of Concern

The above mentioned activities have the potential to contribute to various pollutant levels in the local air shed. The following sections describe the potential pollutants of concern.

2.5.1 Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless gas produced by the incomplete combustion of fuels containing carbon (e.g. oil, gas, coal and wood). CO is absorbed through the lungs of humans, where it reacts to reduce the blood's oxygen-carrying capacity. In urban areas, motor vehicles account for up to 90 percent of all CO emissions.

An increase in motor vehicles (including trains and trucks), plant/machinery and shipping vessels during the construction and operational phase of the PKOHD could potentially contribute to increased levels of CO.

2.5.2 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a brownish gas with a pungent odour. It exists in the atmosphere in equilibrium with nitric oxide. The mixture of these two gases is commonly referred to as nitrogen oxides (NO_x). NO_x is a product of combustion processes. In urban areas, motor vehicles and industrial combustion processes are the major sources of ambient NO_x. NO_2 can cause damage to the human respiratory tract, increasing a person's susceptibility to respiratory infections and asthma. NO_2 can also cause damage to plants, especially in the presence of other pollutants such as O_3 and SO_2. NO_x are also primary ingredients in the reactions that lead to photochemical smog formation.

An increase in motor vehicles (including trains and trucks), plant/machinery and shipping vessels during the construction and operational phases of the PKOHD could potentially contribute to increased levels of NO_2.

2.5.3 Sulfur Dioxide

Sulfur dioxide (SO_2) is a colourless gas with a sharp, irritating odour. It is formed in combustion processes through burning fossil fuel containing sulfur, in petroleum refining and smelting mineral ores. SO_2 may be oxidised in the atmosphere to form sulfuric acid, which contributes to acid rain. SO_2 affects human health by causing respiratory tract infections. People with pre-existing respiratory conditions such as asthma are most sensitive to SO_2 exposure. The simultaneous presence of airborne particulate matter can compound these effects. SO_2 and its aerosols can also damage vegetation and some materials.

An increase in motor vehicles (including trains and trucks) and shipping vessels during the construction and operational phases of the PKOHD could potentially contribute to increased levels of SO_2.

2.5.4 Particulate Matter

Particulate matter is the term for solid or liquid particles found in the air. Some particles are large or dark enough to be seen as soot or smoke, but fine particulate matter is tiny and is generally not visible to the naked eye. Particulate matter is produced by the mechanical breakup of larger solid particles. The larger or coarse fraction can include dust from roads, agricultural processes, uncovered soil or mining operations, as well as noncombustible materials released when burning fossil fuels. Pollen grains, mould spores, and plant and insect parts can also contribute to the coarse fraction. Evaporation of sea spray can produce large particles near coasts. The smaller or fine particulates are largely formed by the oxidation of primary gases.

There are two main effects of particulate; nuisance effects and health effects. Nuisance effects are primarily due to deposited dust and the coarser fraction of total suspended particulate. Health effects are primarily due to particles in the size range less than 10 μm in diameter (PM_{10}) and particles less than 2.5 μm in diameter ($PM_{2.5}$). PM_{10} refers to the range of particulate matter that is inhalable and is able to penetrate the nose or mouth under normal breathing conditions. $PM_{2.5}$ is respirable and is able to penetrate the nasal cavity and ultimately the lungs.

Deposited dust refers to the larger fractions that fall from the air and deposit on exposed surfaces. In general, deposited dust has an aerodynamic diameter of greater than about 20 μm, however there is no sharp size cut off between these particles and the smaller particles that remain suspended in the air for long periods. Larger dust particles are generally responsible for nuisance (amenity) effects. Dust can have a range of nuisance effects including vegetation damage and surface soiling. Depending on its physical or chemical characteristics, dust may also cause surface deterioration of materials due to its abrasive or corrosive properties. If the dust composition is dangerous then it is considered a hazardous air pollutant (and may contain toxic material).

Local particulate matter levels could be contributed to by an increase in vehicle use and plant/machinery during the construction and operation phase of the development (especially if there is an increase in diesel motors), as well as from any activities that handle coal, minerals or other similar products, or that disturb soil during the construction phase. This would include the loading/unloading of ships, especially where dusty materials are being handled. Land reclamation also has the potential to expose new unsealed dirt areas to winds, increasing the potential for dust emissions from these areas.

2.5.5 Lead

Lead has been monitored in the Illawarra region at various sites since 1970 as a check on emissions from the operation of particular point sources as well as ambient sources. Although many heavy metals are present in the Illawarra air shed, lead will be a focus of this assessment. The development has the potential to contribute to local lead levels if materials containing lead (e.g. concentrates for processing) are to be transferred through the port.

2.5.6 Toxic Air Pollutants

Toxic air pollutants, also known as hazardous air pollutants, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. Examples of toxic air pollutants include benzene, which is found in gasoline; perchlorethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries.

Health effects associated with these pollutants are affects on the immune system, as well as neurological, reproductive, developmental, respiratory and other health problems. Benzene is the toxic air pollutant that is typically monitored and used as an indication of the overall toxic air pollution quality.

2.5.7 Odour

Odour is a sensory response to the inhalation of one or more chemicals in the air we breathe. A person's perception of an odour can vary significantly depending on the sensitivity of the person, the acuteness of the person's sense of smell and the connotations that the odour bestows on that person. Odour primarily affects a person's quality of life and can have a large range of adverse effects including stress and other physical symptoms.

Odour is not monitored by state environmental agencies nor by industry; however odorous emissions do need to be taken into account in any air pollution assessment, as many air pollution complaints in residential (and sometimes industrial) areas often relate to odour. Many industries in and around the assessment area contain potential odour sources.

Odour will primarily be a pollutant of concern during the dredging operations of the construction phase of the PKOHD.

3.0 Pollutant Assessment Criteria

3.1 Overview

In NSW the DECCW Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005), is the primary source of pollutant criteria. The Commonwealth National Environmental Protection (Air Toxics) Measure (Air Toxics NEPM) provides additional criteria for air quality. This assessment compares all three documents to the background data available from local monitoring stations.

As previously listed, the pollutants of potential concern investigated in this assessment included the following criteria pollutants:

- Carbon monoxide (CO);
- Nitrogen oxides (NO_x reported as NO_2);
- Sulfur dioxide (SO_2); and
- Particulate matter: PM_{10} (particles less than 10 μm in diameter), $PM_{2.5}$ (particles less than 2.5 μm in diameter) and deposited dust.

Some toxic air pollutants were briefly examined in terms of long term trends due to limited monitoring data. The air toxics included were benzene, toluene, and xylenes.

Odour was highlighted as a pollutant of potential concern (in terms of nuisance effects). Odour has not been monitored by any regulatory authorities in the Illawarra region, and as such no background data can be referenced. The NSW EPA *Protection of the Environment Operations Act (POEO) (1997a)* requires that “offensive odours” should not be emitted by any facility or operation. Offensive odour is described as an odour which may cause harm to a person or interfere unreasonably with the comfort or repose of any person.

3.2 Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005)

The NSW DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005), hereon referred to as the Approved Methods, lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources. **Table 1** presents the Approved Methods air quality impact assessment criteria for the air pollutants of potential concern for the PKOHD.

Table 1: NSW DECCW Approved Methods Air Quality Impact Assessment Criteria for Pollutants of Concern

Pollutant	NSW DECCW Air Quality Criteria		Averaging Period
	pphm	$\mu g/m^3$	
Carbon monoxide (CO)	8,700 2,500 900	100,000 30,000 10,000	15 minutes 1 hour 8 hour
Benzene	0.009	29	1 hour
Nitrogen Dioxide (NO_2)	12 3	246 62	1 hour Annual
Sulfur Dioxide (SO_2)	25 20 8 2	712 570 228 60	10 minute 1 hour 24 hour Annual
PM_{10}	- -	50 30	24 hour Annual
Lead (Pb)	-	0.5	Annual
Units	**g/m^2.month**	**g/m^2.month**	
Deposited Dust	2 *	4 **	Annual

ppm: parts per million
pphm: parts per hundred million
$\mu g / m^3$: micrograms per cubic metre
mg / m^3: milligrams per cubic metre
* The maximum increase in deposited dust
** The maximum total deposited dust level

3.3 National Environmental Protection (Ambient Air Quality) Measure and National Environmental Protection (Air Toxics) Measure

Commonwealth *National Environmental Protection (Ambient Air Quality) Measure* (Air NEPM) and monitoring investigation levels in the Commonwealth *National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) are used to assess whether pollutant levels could harm public health.

The desired environmental outcome of the Air NEPM is ambient air quality that provides for the adequate protection of human health and well being. The goal of the Air NEPM is to achieve the standards with the allowable exceedences, as assessed in accordance with the associated monitoring protocol. The Air NEPM goals apply to air quality experienced by the general population within a region, and not to air quality in areas within the region impacted by localised air emissions such as heavily trafficked streets. The ambient air quality goals defined in the Air NEPM are listed in **Table 2**.

Table 2: Air NEPM Air Quality Goals

Pollutant	Air NEPM Goals	Averaging Period
Carbon monoxide (CO)	9.0 ppm	8 hour*
Nitrogen Dioxide (NO_2)	0.12 ppm 0.03 ppm	1 hour* Annual
Sulfur Dioxide (SO_2)	0.20 ppm 0.08 ppm 0.02 ppm	1 hour* 24 hour* Annual
PM_{10}	50 $\mu g/m^3$	24 hour**
$PM_{2.5}$	25 $\mu g/m^3$ 8 $\mu g/m^3$	24 hour (advisory only) Annual (advisory only)
Lead (Pb)	0.50 $\mu g/m^3$	Annual

ppm: parts per million
$\mu g / m^3$: micrograms per cubic metre
* Not to be exceeded more than one day per year
** Not to be exceeded more than five days per year

The Air Toxics NEPM provides a framework for monitoring, assessing and reporting on ambient levels of air toxics. The Air Toxics NEPM includes monitoring investigation levels for use in assessing the significance of monitored levels of air toxics with respect to human health. The monitoring investigation levels are levels of air pollution below which lifetime exposure, or exposure for a given averaging time, does not constitute a significant health risk. If these limits are exceeded in the short term, it does not mean that adverse health effects automatically occur. If the monitoring investigation levels are exceeded, then some form of further investigation by the relevant jurisdiction of the cause of the exceedence is required. The relevant monitoring investigation levels defined in the Air Toxics NEPM are listed in **Table 3**.

Table 3: Air Toxics NEPM Air Quality Monitoring Investigation levels

Pollutant	Air Toxics NEPM Monitoring Investigation Level	Averaging Period
Benzene	0.003 ppm	Annual
Toluene	1 ppm 0.1 ppm	24 hour Annual
Xlyenes (as a total of ortho, meta and para isomers)	0.25 ppm 0.2 ppm	24 hour Annual

ppm: parts per million

DECCW instrumentation is only capable of measuring levels of the *p*-xylene isomer, not total xylene. However, monitoring studies conducted in urban environments around the world have shown that *p*-xylene consistently comprises about 20 percent of the total xylene present in the atmosphere, providing the basis for an estimate of total xylene concentrations to be made.

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4.0 Existing Ambient Air Quality

4.1 Surrounding Sources of Potential Air Pollution

Port Kembla is dominated by heavy and light industry, with some mixed commercial use and residential areas. Sources of air pollution identified include point sources (specifically stack sources), ground level sources such as construction sites, fugitive emission sources (for example, petroleum storage tanks, coal storage and despatch and transport corridors) and motor vehicle sources at construction sites, ship movements and on transport corridors (including trains).

- Significant, or potentially significant, sources of air pollution (criteria pollutants, toxic air pollutants, dust and odour) in the area surrounding the site include:BlueScope Steel;
- Orica;
- Incitec Limited (fertiliser manufacturer);
- GrainCorp Operations Limited;
- Port Kembla Coal Terminal;
- Port Kembla Copper; and

Various light industrial sources (steel workshops, equipment hire etc).The site upon which the Outer Harbour development will be developed is mostly unsealed and poorly vegetated. Areas of exposed dirt are prone to wind generated dust emissions and can contribute to dust levels in the local area. The Outer Harbour development will involve the sealing of a high percentage of these dirt areas, hence reducing the potential area for wind generated dust emissions.

4.2 Pollutant Monitoring Data

Ambient pollutant concentrations for criteria pollutants (where available) and toxic air pollutants from nearby DECCW monitoring sites were used to examine the existing ambient air quality in the assessment area.

In order to gain a general idea of the existing ambient air quality in the assessment area, reference was made to the following documents:

- *Ambient Air Quality Research Report (1996-2001); Dioxins, Organics, Polycyclic Aromatic Hydrocarbons and Heavy Metals* (2002), NSW Environment Protection Authority (EPA), Sydney; and
- *Quarterly Air Quality Monitoring Reports*, Department of Environment and Climate Change NSW, Sydney.

The DECCW monitors air quality in NSW to check compliance with ambient air quality guidelines, identify long term trends in air quality, assess the effectiveness of air quality management strategies and to disseminate information about air quality. The results are published as quarterly air quality monitoring reports. Air pollutants monitored by the DECCW in NSW include CO, O_3, NO_x (reported as NO_2), SO_2, benzene, toluene, p-xylene, PM_{10}, $PM_{2.5}$ and visibility reducing particles. Not all pollutants are measured at all monitoring sites. The Wollongong monitoring station at Gipps Street was the closest to the assessment area monitoring the appropriate pollutants and was used to interpret the air quality for relevant pollutants.

From early 1996 to August 2001 the NSW Environmental Protection Agency (EPA) conducted a study to assess the presence of air toxics on a regional scale encompassing the Sydney, Newcastle and Illawarra regions (EPA 2002). The primary aim of the program was to obtain data on the concentration of a wide range of dioxins, 11 Polycyclic Aromatic Hydrocarbons (PAHs), 12 heavy metals and 41 organic compounds.

4.2.1 Dust Deposition Gauge Results

The results from the Dust Deposition Gauges (DDG) located around the PKOHD from October 2001 to October 2007 have been examined in this assessment. DDG were located at two sites designated by the IDs east and west. DDG results reflect the long-term dust levels in a local area as opposed to assessing contributions from a specific activity or operation. The gauges collect dust that settles gravimetrically, and can be contributed to by a variety of sources in the local environment. DDG measure the total dust settled and does not differentiate between particulate sizes.

DDG results are assessed using the NSW DECCW Approved Methods residential amenity criteria value of 4 g/m^2.month (Insoluble Solids). The DDG results have been summarised by ID and year in **Table 4**.

Table 4: Dust Deposition Gauge Results for the Outer Harbour Development October 2001 to October 2007

Year	ID	Dust Concentration (g/m^2.month)		
		Average	Maximum	Minimum
2001	East	**4.1**	**6.7**	1.4
	West	2.0	2.5	1.7
2002	East	2.8	**9.2**	0.8
	West	**4.7**	**8.3**	2.8
2003	East	2.8	**4.2**	1.5
	West	3.2	**5.5**	1.3
2004	East	2.0	**5.0**	1.2
	West	3.0	**5.7**	1.2
2005	East	3.2	**7.2**	1.1
	West	**4.3**	**12.3**	0.9
2006	East	2.2	**8.4**	0.1
	West	3.3	**5.7**	1.2
2007	East	2.2	**5.4**	0.3
	West	**4.2**	**7.5**	0.7
All Data	East	2.6	**9.2**	0.1
	West	3.7	**12.3**	0.7
	All	3.2	**12.3**	0.1
NSW DECCW Criteria		4 g/m^2.month (residential amenity)		

Bold denotes exceedence

The tabulated results shows that the dust deposition rates averaged over all monitored years for both the east and west locations were below the 4 g/m^2.month criteria. However, a review of the individual monthly results shows that from a possible 61 months of monitoring data there are 10 months for the east location and 21 months from the west location where monitoring data exceeds the NSW DECCW criteria.

The most recent data available is for 2007. The annual average for this year is below the criteria for the east location and above the criteria for the west location. The monthly results show that from a possible 10 months there are no months for the east location and 5 months from the west location that exceed the NSW DECCW criteria.

The results show that generally the DDG results from the west location are higher than those from the east location. The west location is situated closer to industrial areas which are potential sources of dust emissions.

4.2.2 Long Term Air Toxic Trends

Ambient Air Quality Research Project (EPA, 2002)

On a regional scale, the NSW EPA *Ambient Air Quality Research Project* (2002) summarises the results of five and a half years of monitoring data from the Sydney, Newcastle and Illawarra regions. There were four monitoring stations in the Illawarra region, including the Wollongong CBD. Relevant comments and trends observed from the project for PAHs, heavy metals, and organic compounds are summarised below:

Polycyclic Aromatic Hydrocarbons (PAHs)

- PAHs are a mixture of organic compounds released into the atmosphere as gases and particles during the incomplete combustion of organic material. Typical sources are motor vehicles, steel works, waste incineration, the burning of wood and coal for heating, and bushfires.
- In the EPA project the most common 11 PAHs were collated together as 'total PAHs'.
- **Table 5** presents the 24 hour average total PAHs (in ng/m^3) for Wollongong and Sydney (for comparison) for both winter and summer.

Table 5: Total PAHs as 24 hour averages (ng/m^3) winter and summer for Wollongong and Sydney (EPA, 2002)

Parameter	Wollongong		Sydney	
	Winter	Summer	Winter	Summer
Average	1.71	0.62	4.47	0.62
Max	9.62	1.79	17.5	1.39

- The results show that, as expected, the winter months are more conducive to higher levels of pollutants. Factors that contribute to the high levels are; less mixing in the atmosphere due to stronger and more frequent temperature inversions resulting in pollutants being trapped in a shallow layer at the ground, as well as increased use of solid fuel heaters mostly for home heating.
- The report further details that autumn and spring had lower results than winter, although not as low as summer, and that as a general rule, the annual average PAH value would be approximately one quarter to one half of the winter value.
- The data shows that Wollongong has better air quality in terms of PAHs present in the atmosphere than Sydney during the winter period. In summer levels are either equal to or greater than that of Sydney.
- No ambient PAH standards have been set, however guideline values for benzo(a)pyrene (BaP) have been developed. BaP is considered as a good indication for the presence of PAHs. The UK has proposed an annual average BaP goal of 0.25 ng/m^3 (from 2010) and the EU are considering a BaP goal of between 0.5 and 1.0 /m^3. The results in the EPA study show that the average BaP value for Wollongong was 0.16 and 0.03 ng/m^3 in winter and summer respectively. The average values for both seasons met the UK and European goals.

Heavy Metals

- 12 heavy metals were assessed in the EPA project, with the Illawarra monitoring stations being located at Gipps Street, Wollongong and at Albion Park.
- All metals showed low levels and were generally below recognised international standards, although direct comparison with annual goals was not possible. Copper, lead, manganese, nickel, vanadium and zinc accounted for 95% of the total metal concentration.
- **Table 6** presents the results for lead. The table shows that all results were well below ambient air quality goals.

Table 6: Concentrations of Lead and Air quality Goals (EPA, 2002)

Metal	Mean of Samples (24-hour: ng/m^3)	Range of Samples (24-hour: ng/m^3)	Ambient Air Goals (annual average: ng/m^3)	Source
Lead	29.9	3.4 - 99	500	NEPM, WHO* and DECCW

* WHO – World Health Organisation

- **Organic Compounds**Only 19 of the 41 targeted organic compounds were identified in more than 1% of the samples taken. The majority of these 19 compounds were associated with motor vehicle emissions, with industry the primary source of only three of these compounds **Table 7** presents the 19 compounds found classified by their most likely source.

Table 7: Organic compounds detected by the Ambient Air Quality Research Project (EPA, 2002) classified by likely source

Likely Source	Source Organic compound
Motor vehicles	Toluene
	Benzene
	Xylenes (para and meta)
	Xylenes (ortho)
	1,2,4-trimethylbenzene
	Ethylbenzene
	1,3-butadiene
	4-ethyltoluene
	Styrene
	1,3,5-trimethylbenzene
Ozone-depleting substances	Freon® (11, 12 and 113)
	Carbon tetrachloride
	1,1,1-trichloroethane
Industrial	Dichloromethane
	Trichloroethylene
	Tetrachloroethylene
Natural, domestic and industrial	Chloromethane

- The EPA research project concluded that Wollongong CBD had 'good air quality' with respect to organic air toxic levels.
- A comparison against international goals found that no organic compounds exceeded the goals at any time. In fact, the annual average concentration of benzene was below both the UK (2003) goal of 5 parts per billion by volume (ppbV) and the European Commission (2010) long term goal of 1.5 ppbV.

DECCW Quarterly Air Quality Monitoring Reports

The Illawarra region has three active monitoring sites; Wollongong, Kembla Grange and Albion Park South. The Wollongong CBD location on Gipps Street Wollongong was deemed the most appropriate for the assessment as both Wollongong and the PKOH are located in similar coastal environments and it is the closest monitoring station to Port Kembla at approximately 6km north (although the CBD station will be impacted less by industry than the Outer Harbour site).

Table 8 presents the results from the DECCW quarterly air quality monitoring reports for the Wollongong monitoring station.

Table 8: DECCW Air Pollutant Data for the Wollongong Monitoring Station

Pollutant	Averaging Period	Yearly data ug/m^3				Maxima ug/m^3	Average ug/m^3	Criteria ug/m^3
		2004	2005	2006	2007			
CO	1 Hr maximum	4,000	4,250	3,375	3,625	4,250	-	30,000
	8 Hr maximum	2,625	3,250	1,875	1,875	3,250	-	10,000
NO_2	1 Hr maximum	126	166	143	109	166	-	246
	Annual average	26	26	26	26	-	26	62
SO_2	1 Hr maximum	152	109	100	92	152	-	570
	24 Hr maximum	43	17	20	26	43	-	228
	Annual average	3	3	3	4	-	3	60
PM_{10}*	24 Hr maximum	48	**55**	**62**	**53**	62	-	50
	Annual average	18	19	20	20	-	19	30
$PM_{2.5}$**	1 Hr maximum	79	66	81	75	79	-	NA
	Annual average	**10**	**9**	**9**	**10**	-	10	8**

Exceedences in **Bold**

* PM_{10} and $PM_{2.5}$ data derived from TEOM measurements.

** Advisory criteria provided in NEPM.

- The data shows that there were no recorded exceedences of any listed air quality criteria for CO, NO_2, and SO_2 for all monitored periods.
- The PM_{10} 24 hour maximum value criteria of 50 ug/m^3 (DECCW and NEPM) was exceeded for every year except 2004. The maximum exceedence was 12 ug/m^3 in 2006 while the lowest exceedence was 3 ug/m^3 in 2007.
- The PM_{10} annual average of 30 ug/m^3 (DECCW and NEPM) was met for all monitored periods.
- The NEPM $PM_{2.5}$ criteria is advisory only, and was established as a long term objective. The $PM_{2.5}$ annual average criteria (advisory only) of 8 ug/m^3 (NEPM) was exceeded for all monitored periods. All years exceeded by 2 ug/m^3 or less.
- The most recent year monitored was 2007 and in that year values were below the calculated maxima for each parameter and 2007 results were generally lower than past years for most parameters. This shows that the air quality in recent times has improved compared to past years.

4.3 Implications for the Assessment Area

Based on the information referenced in this assessment, only one major concern was identified relating to the existing air quality in and around the assessment area. Exceedences of the air quality criteria and goals were presented in the DECCW quarterly monitoring particulate matter results for both PM_{10} and $PM_{2.5}$. As the $PM_{2.5}$ criterion is advisory the assessment will focus on the PM_{10} results. There is the potential for health effects associated with this pollutant at exceedence levels. Particles smaller than 10µm have the potential to enter the human respiratory system and penetrate deeply into the lungs, causing adverse effects.

In general PM_{10} is generated by natural events such as bush fires and dust storms as well as by diesel and petrol motor vehicles and other combustion processes that burn fossil fuels, such as power generation, industrial processes and domestic solid fuel heaters. The development has the potential to include vehicle use, plant, machinery and industrial activities and hence has the potential to further contribute to the already high PM_{10} ambient levels in the region.

It is the responsibility of the development, as provided under the NSW DECCW key environmental requirements (dated 19 December 2008), to ensure that ‘dust emissions are minimised or prevented’ at the site. The development can limit its impact on the local PM_{10} levels by employing ‘Best Practice’ dust management strategies during the construction and operation phases of the development, as discussed in **Section 7.0** of this report.

Analysis and/or atmospheric dispersion modelling of pollutants, in particular $PM_{10,}$ may be required on a case by case basis for new developments to identify worst case air pollution scenarios and pollutant “hot spots”. Pollutant hot spots can be used to identify local air quality impacts and areas unsuitable for highly sensitive land uses (such as childcare centres, schools and recreation areas).

5.0 Meteorology

Meteorological data was sourced from the DECCW Wollongong Monitoring Station located at the Army Barracks on Gipps Street. Continuous hourly averaged data was sourced from the DECCW to assess the wind speed and direction in the general vicinity of the development site. There are no significant topographical features between the Gipps Street station and the development site that would indicate that the station data would not be representative of the meteorological patterns in the area. Both sites are located close to the coast line, so coastal wind effects should be similar at both locations.

5.1 Wind Data

Wind rose diagrams for the Wollongong monitoring station for the period July 2006 to June 2007 for annual and seasonal data are shown in **Figures F3** to **F7**. The wind roses show the frequency of occurrence of winds by direction and strength. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e., northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds.

General observations of the wind rose data shows:

- Annual wind patterns are dominated by winds from the south west in the morning and winds from the north east in the afternoon;
- Summer wind patterns are characterised by increasing north east winds in both the morning and afternoon;
- Autumn winds are dominated by south westerly winds in the morning and north easterly winds in the afternoon as sea breezes take effect;
- Winter winds are generally more settled than those in other seasons. Predominant winds in the morning are from the south west, with more unsettled winds in an arc clockwise from north east to west in the afternoon; and
- Spring winds in the morning are erratic and come from most directions with predominance from the south west and north east, with afternoon winds from the north east.

In general, offshore winds will dominate in the morning and onshore winds (predominantly from the north east) will dominate in the afternoon. This may have some effect on pollutant transport in the afternoon with onshore winds transporting pollutants from existing industrial sources towards inland areas.

The wind speed frequency distribution by hour for the data is presented in **Figure 1**. The data shows that winds are highest during daylight hours with a peak average speed around 1300 to 1500 (1pm to 3pm). This data shows that pollution will be dispersed by winds more effectively in the daytime than at night. This may lead to higher near field pollution concentrations during the night if 24 hour operating activities are assumed.

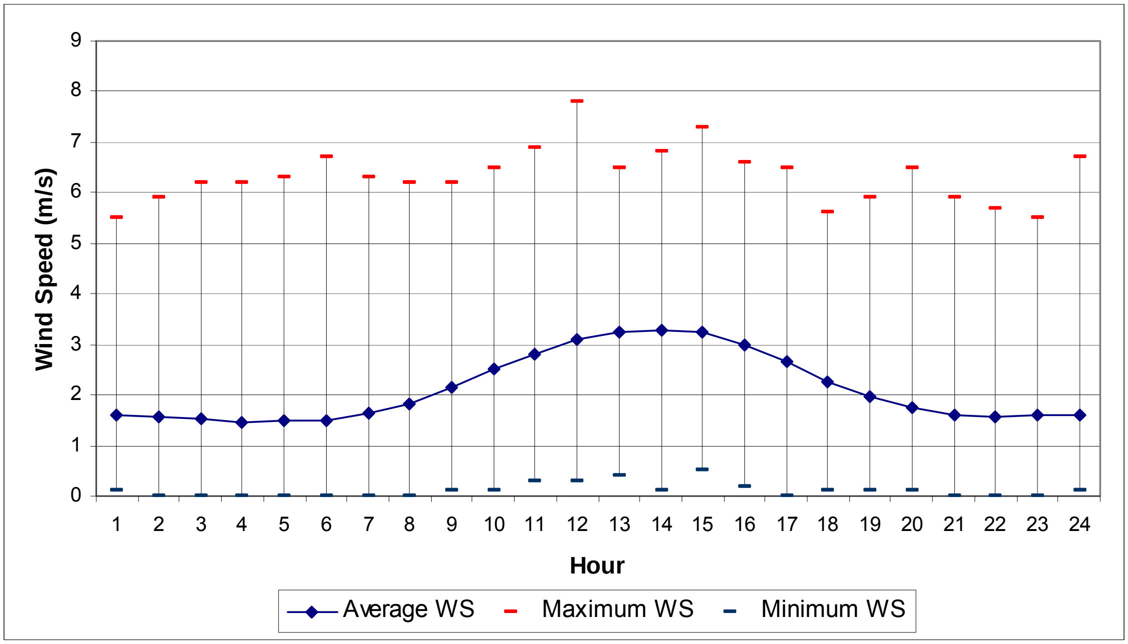

Figure 1: Hourly Wind Speed Frequency for Wollongong July 2006 - June 2007

The wind speed frequency distribution by wind speed category is provided in **Figure 2**. The data shows that there is a relatively even spread of wind speeds between 0.5 and 6 m/s, with very little winds less than 0.5 or greater than 8 m/s. No winds were recorded for wind speeds greater than 10 m/s. It should be noted that there is a very low occurrence of low wind speeds, for which the reason is unclear. The likely cause may be due to the stall speed of the wind speed sensor.

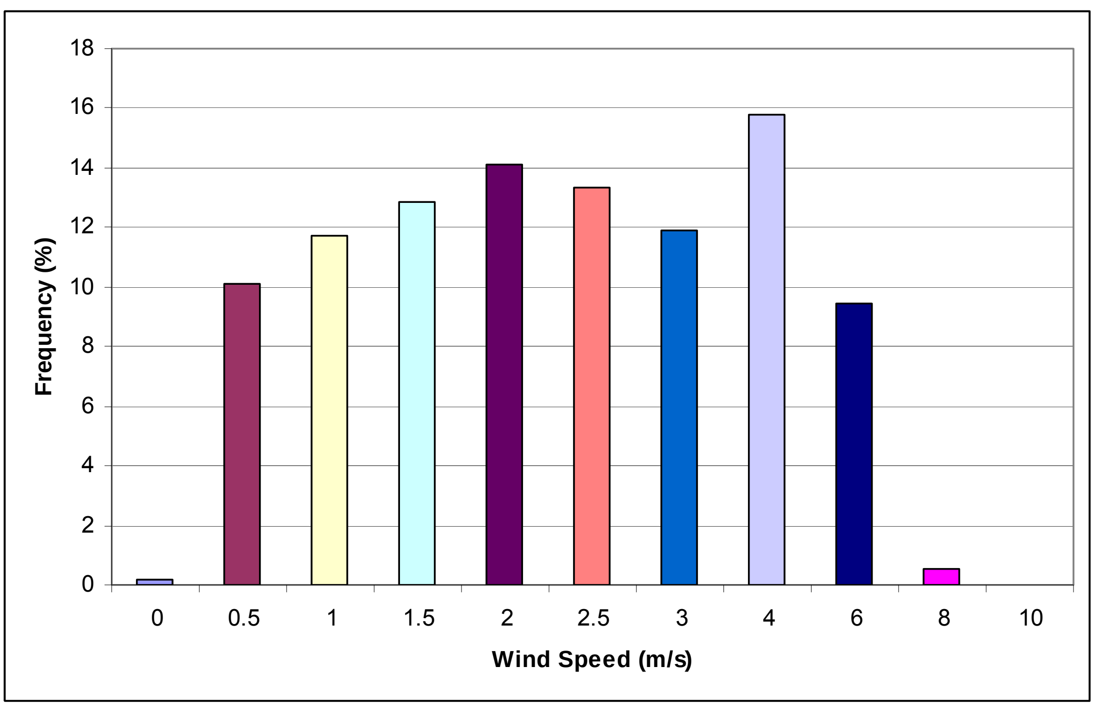

Figure 2: Wind Speed Frequency Distribution by Wind Speed Category for Wollongong July 2006 - June 2007

5.2 Stability Class

An important aspect of plume dispersion is the atmospheric turbulence level in the region of the plume. Turbulence acts to increase the cross-sectional area of the plume due to random motions, thus diluting or diffusing a plume. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe atmospheric conditions and thus dispersion.

The most well-known stability classification is the Pasquill-Gifford scheme, which denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind. Intermediate stability classes grade from moderately unstable (B), slightly unstable (C), neutral (D) through to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds. The frequency distribution of estimated stability classes in the Wollongong meteorological data is shown in **Figure 3**. The data shows a total of 50% of hours were either A, B or C class. This is consistent with the expected occurrence of moderately unstable conditions at such a coastal location. This should result in greater atmospheric mixing and dilution of pollutants in the region. Class F (very stable conditions) are present approximately 28% of the time, resulting in possible far-field impacts during these times.

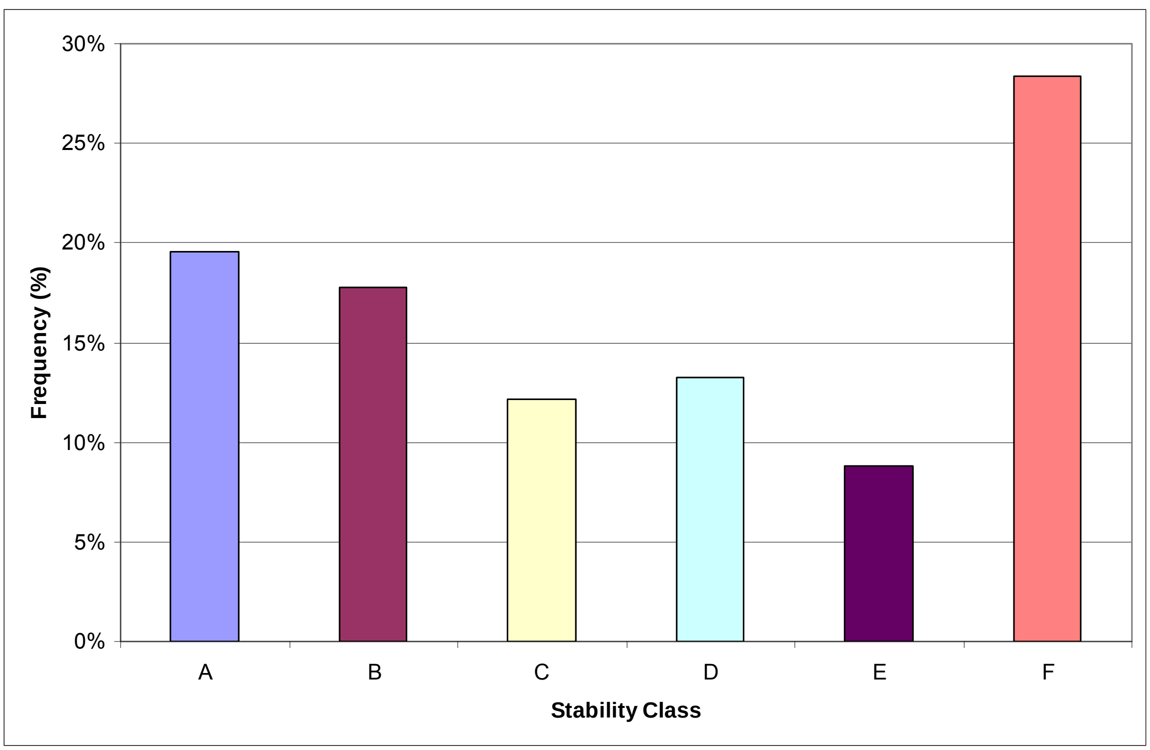

Figure 3: Frequency Distribution of Stability Class for Wollongong

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6.0 Air Dispersion Modelling Methodology

6.1 Overview

Dispersion modelling was undertaken to predict the potential air quality impacts from the PKOHD Concept Plan and Major Project (Stage 1). The scenarios modelled in the AQIA are as follows:

- Scenario 1a – Major Project Construction
- Scenario 1b – Major Project Operation
- Scenario 2 – Concept Plan Operation

It is expected that construction activities during the Major Project construction represent the worst case impacts due to the majority of the earthworks (reclamation activities) being undertaken during this period. As such, Concept Plan construction activities were not modelled in the AQIA. Future project applications will be required for the Concept plan and future construction impacts may be required to be assessed during these stages.

The scope of work undertaken by AECOM to assess the potential air quality impacts from the PKOHD is as follows:

- **Development of an Emissions Inventory**. The inventory contains all emissions information required to undertake dispersion modelling. The inventory was generated using operational information supplied by PKPC and the emission factors supplied in relevant documents (Commonwealth 2008a and 2008b, EPA 1997a).
- **Dispersion Modelling**. The AUSPLUME dispersion model was used in the AQIA. Model inputs include meteorology, source characteristics, modelling scenarios and pollutant emissions data.
- **Report Preparation**. This report was prepared to present the findings of the dispersion modelling. The report outlines the methodology, assumptions, model inputs, findings and recommendations of the AQIA.

As required by the DGRs, the AQIA was conducted in accordance with the following guideline:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales,* Department of Environment and Conservation New South Wales (DEC) 2005, hereafter referred to as the Approved Methods.

The Approved Methods outlines the requirements for developing air dispersion modelling methodology, analysing meteorological data, and the criteria applicable when considering the potential impacts as a result of a site's operation.

The AUSPLUME prognostic air dispersion model was used in the AQIA. The model uses the Gaussian dispersion model equations to simulate the dispersion of a plume from point, area or volume sources. Mechanisms for determining the effect of terrain on plume dispersion are also provided. The dispersion of each pollutant plume is determined for each hour using conventional Gaussian model assumptions. It should be noted that Gaussian models are best used to identify pollutant concentrations at receptor locations close to emissions sources, as they can overestimate concentrations at longer distances.

Atmospheric dispersion modelling was conducted using AUSPLUME 6.0 (the latest approved version of the model) in accordance with the DECCW Approved Methods (DEC NSW, 2005). The document prescribes calculation modes for accounting for terrain effects, building wake effects, horizontal and vertical dispersion curves, buoyancy effects, surface roughness, plume rise, wind speed categories and wind profile exponents.

Input parameters used in the AUSPLUME dispersion modelling are summarised in **Table 9**.

Table 9: Summary of AUSPLUME Input Parameters

Parameter	Input
AUSPLUME Version	6.0
Modelling Domain	5 km x 5 km
AUSPLUME Modelling Grid Resolution	0.1 km
Number of Sensitive Receptors	10
Terrain Data	Not Required
Building Wake Data	Not included in model
Dispersion Algorithm	PG (urban ISC curves) & MP Coeff. (urban)
Hours Modelled	8760 hours (365 days)
Meteorological Data Period	1 July 2006 – 31 June 2007

6.2 Emissions Inventory

The emissions from ship and rail operations and bulk material handling on site were estimated using the following National Pollution Inventory (NPI) and US EPA AP42 emission estimation technique manuals:

- Emission Estimation Technique Manual for Railway Yard Operations Version 2, June 2008 (Commonwealth 2008a).
- Emission Estimation Technique Manual for Maritime Operations Version 2, July 2008 (Commonwealth 2008b).
- Emission Estimation Technique Manual for Mining Operations Version 2.3, December 2001 (Commonwealth 2001).
- AP42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources *Large Stationary Diesel and All Stationary Dual-fuel Engines* (US EPA, October 1996).

The manuals provide emission factor equations that are applied to the operational data of the shipping to generate emission inputs for the modelling process.

The engine capacity of the dredging equipment used in the Major Project construction period has been gained from the *Royal Boskalis Westminster N.V* website (http://www.boskalis.com, accessed 22 December 2009). Royal Boskalis Westminster N.V. is a leading global services provider operating in the dredging, maritime infrastructure and maritime services sectors. The average engine capacity of the backhoe dredger (1010 kW) and grab dredger (654 kW) listed on the website were applied in the AQIA.

The emissions from truck movements on the site have been estimated using the following air quality study:

- Environment Protection Authority New South Wales (EPA) (1997a) *Metropolitan Air Quality Study: Air Emissions Inventory*.

The Metropolitan Air Quality Study (MAQS, 1997a) was undertaken to develop a computerised air emission inventory, analyse meteorological data/modelling of air movements, investigate air chemistry and urban airshed modelling. The study provides vehicle emission rates for various types of vehicles and fuel types.

The emissions from ship operations and train movements on site were estimated using the NPI manuals (2008a and 2008b). The truck movement emissions were estimated using the EPA MAQS (1997a). Due to a lack of information regarding stack flow rates, emission concentrations etc, the ship stacks were modelled as volume sources and are likely to result in conservative predicted impacts.

The emission rates for trains were based on estimated train operations for the port in regards to the time that selected throttle levels are used on-site. Train operations were determined based on discussions with PKPC and its nominated rail consultant who has been recently appointed to prepare the Rail Masterplan for the Outer Harbour.

The fuel consumption values used below were gained from the handbook "*Train controllers guide to fuel conservation with train operation*" published by V/Line (1986). A summary of the throttle fuel consumptions applied in the AQIA are provided below:

- Idle fuel consumption of 24 L/h/locomotive;
- Throttle 5 fuel consumption of 290 L/h/locomotive; and
- Throttle 3 fuel consumption of 146 L/h/locomotive.

6.2.1 Revision of Emissions Inventory

This report is a revision of the AQIA placed on public exhibition on 11 February 2010 to address issues arisen by the DoP and the DECCW. While addressing the issues, selected underlying assumptions and methodologies were revisited, in particular those regarding the modelling approach taken for ships and trains movements. The revisions were required to refine the input information to better reflect operational characteristics and correct some inconsistencies noted in the original emissions inventory. The revised emissions inventory is provided in **Appendix A** and a summary comparison of the original and revised emission inventory is provided in **Appendix B**. The approach to modelling trains was a key revision of the AQIA and has been detailed below.

The inclusion of trains and trucks within dispersion models has historically been undertaken using separated volume sources along the line of movement. Although a vehicle's exhaust may physically represent a stack source (has a defined diameter, initial vertical momentum and thermal buoyancy), it is thought that modelling vehicles as volume sources may account for the impacts of horizontal wind resistance due to the vehicles forward movement on the initial vertical momentum from the vehicles exhaust. Although this historical approach is considered to be conservative, it may not be appropriate for vehicles that are predominantly stationary (or moving at very slow speeds). This approach was applied to all trains in the original version of the AQIA submitted for public exhibition, however has been revisited in this revised version.

Trains from the South Yard are expected to be predominantly stationary or moving at very low speeds (shunting operations for breaking and forming trains) and as such have been modelled as stack sources in the Major Project Operations and Concept Plan Operation scenarios (1b and 2 respectively). It is thought that by modelling these selected trains as stack sources the emissions (including initial vertical velocity and temperature parameters) will be more representative of actual release conditions. It should be noted that the throttle levels and times used in the modelling are based on expected maximum typical operations using conservative assumptions, and therefore the modelling of trains in the South Yard as stack sources is still expected to result in conservative predictions of impacts.

Although vehicle traffic speeds onsite will be strictly limited, onsite truck movements and train operations at the multi-purpose and container berths have been modelled as separated volume sources. These activities are considered to be moving over considerable distances (when compared to the South Yard) and therefore have been conservatively modelled as volume sources.

The throttle levels and times for the train operations applied in the original AQIA were based on limited information available at that point in time. Due to these limitations overly conservative values were applied in the modelling. Since the submission of the original report, further discussions have been had with PKPC's consultant who has recently been engaged to undertake the Rail Masterplan. Knowledge of the train operations has increased and more accurate information, although still conservative, is now known. As such, a revision of the throttle levels and times to reflect current information was undertaken and applied in the modelling.

The revised throttle levels and times for the train operations during the Major Project Operations and Concept Plan operations are detailed in **Table 10** to **Table 13**. Major Project Construction throttle information has been assumed to remain as stated in the original AQIA. The throttle times for all scenarios are also provided in the assumptions in the emissions inventory in **Appendix A**.

Table 10: Scenario 1b (Major Project Operation) Multi-Purpose Berth – Bulk Freight – Train Movements

Train Movement	Throttle Level	Throttle Time (minutes)	No. of Locos Modelled
Train enters holding siding in South Yard	Throttle 5	15	2
Train idles in holding siding then enters loop and unloads adjacent to multi-purpose berth	Idle	120	1*
Train leaves via Balloon Loop and North Yard	Throttle 5	15	2
Multi-Purpose Berth Bulk Freight - 4 trains per day			

***** One loco will be turned off during selected train operations.

Table 11: Scenario 2 (Concept Plan Operation) Multi-Purpose Berth – Bulk Freight – Train Movements

Train Movement	Throttle Level	Throttle Time (minutes)	No. of Locos Modelled
Train enters holding siding in South Yard	Throttle 5	15	2
Train idles in holding siding then enters loop and unloads adjacent to multi-purpose berth	Idle	120	1*
Train leaves via Balloon Loop and North Yard	Throttle 5	15	2
Multi-Purpose Berth Bulk Freight - 4 trains per day			

***** One loco will be turned off during selected train operations.

Table 12: Scenario 2 (Concept Plan Operation) Multi-Purpose Berth – General Freight – Train Movements

Train Movement	Throttle Level	Throttle Time (minutes)	No. of Locos Modelled
Train enters holding siding in South Yard	Throttle 5	15	2
Train idles in holding siding in South Yard while shunting occurs	Idle	120	1*
Train moves to unloading siding adjacent to multi-purpose berth	Throttle 5	15	1*
Train idles in unloading siding adjacent to multi-purpose berth while unloading, then shunt & reform in holding siding in South Yard	Idle	120	1*
Train leaves holding siding and exit via Balloon Loop and North Yard	Throttle 5	15	2
Multi-Purpose Berth General Freight – 1 train per day			

***** One loco will be turned off during selected train operations.

Table 13: Scenario 2 (Concept Plan Operation) Container Berth Train Movements

Train Movement	Throttle Level	Throttle Time (minutes)	No. of Locos Modelled
Train enters holding siding in South Yard	Throttle 5	15	2
Train idles in holding siding in South Yard while splitting	Idle	60	2
Train moves to container berth sidings	Throttle 5	15	2
Train idles in container berth sidings and returns to holding siding in South Yard to reform before exiting	Idle	60	2
Train leaves from exit siding in South Yard	Throttle 5	15	2
Container Berths – 16 trains per day			

6.2.2 Emission Rates

The emission rates applied in the AQIA for Scenario 1a (Major Project Construction) have been included in the modelling as a variable emission rates file due to varying daytime operations. The file lists the emission rates for each source for each hour of the modelling period for each pollutant, and is summarised in **Table 14** and **Table 15** . The emission rates applied in the AQIA for Scenarios 1b and 2 are inserted directly into the model (no variable file is required) and are provided in **Table 16** to **Table 18.**

The column in the following tables identified as '*No. Of Volume Sources*' is a modelling term and does not relate to the number of vehicles, operational items etc. The column refers to the number of volume sources utilised in the model to represent the selected source. For example, trucks drive over long haul roads so several separated volume sources must be utilised in the model to represent the entire distance travelled by the trucks i.e. a line source. To calculate the total emission rate for a pollutant from a source, multiply the pollutant emission rate by the number of volume sources (provided in the 'No. of Volume Sources' column). A summary of the mass emission rate is also provided in **Table 15, Table 17** and **Table 19.**

Table 14: Scenario 1a (Major Project Construction) Modelling Emissions Inventory

Source	ID	Hour/ day	Source Type	No. of Volume Sources	Emission Rate				
					NO_x	CO	SO_2	PM_{10}	TSP
					Emission Rate per Volume Source (g/s)				
Dredging Ships	DR1	24	Volume	1	6.0	0.14	0.20	0.18	0.18
Trains (Stockpile)	TR7-9	- (1)	Volume	3	0.20	0.12	0.000075	0.016	0.016
Trucks	VS20-25	- (1)	Volume	6	0.018	0.0094	0.000056	0.00012	0.00012
					Emission Rate per Area Source ($g/m^2.s$)				
Construction Stockpile (Wind Erosion)	CONSTK	24	Area	NA	0	0	0	0.0000028	0.0000056
Construction Stockpile (Active Area)	ACTSTK	- (1)	Area	NA	0	0	0	0.00036	0.00088

(1) Construction hours are Monday to Friday 7am to 6pm (11 hours) and Saturday 9am to 1pm (5 hours)

Table 15: Scenario 1a (Major Project Construction) Mass Emission Rates

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Dredging Ships	6.04	0.14	0.20	0.18	0.18
Trains (Stockpile)	0.60	0.35	0.00022	0.047	0.047
Trucks	0.11	0.056	0.00034	0.00074	0.00074
Construction Stockpile (Wind Erosion)*	0	0	0	0.042	0.083
Construction Stockpile (Active Area)*	0	0	0	0.54	1.32
TOTAL	**6.75**	**0.55**	**0.20**	**0.81**	**1.62**

* The areas of the stockpiles are 15,000m^2 for wind erosion and 1,500m^2 for the active area. To gain the mass emission rate multiply the emission rate in $g/m^2.s$ by the surface area.

Table 16: Scenario 1b (Major Project Operation) Modelling Emissions Inventory

Source	ID	Hour/ day	Source Type	No. of Volume Sources	Emission Rate				
					NO_x	CO	SO_2	PM_{10}	TSP
					Emission Rate per Volume Source (g/s)				
Bulk Material Ship	VS2	24	Volume	1	1.43	0.12	1.05	0.10	0.10
Trains (Railyard)	TR1-3	24	Stack*	3	0.10	0.058	0.000037	0.0079	0.0079
Trains (Unloading Siding)	TR4-6	24	Volume	3	0.13	0.077	0.000050	0.011	0.011
Trucks	VS20-25	24	Volume	6	0.0055	0.0028	0.000017	0.000037	0.000037
					Emission Rate per Area Source ($g/m^2.s$)				
Bulk Material Stockpile (Wind Erosion)	OPSSTK	24	Area	NA	0	0	0	0.0000028	0.000006
Bulk Material Stockpile (Active Area)	ACTSTK	24	Area	NA	0	0	0	0.00051	0.0012

* Trains in the South Yard have been included in the modelling as separated stack sources. To calculate the mass emission rate multiply the pollutant emission rate by the number of stacks.

Table 17: Scenario 1b (Major Project Operation) Mass Emission Rates

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk Material Ship	1.43	0.12	1.05	0.10	0.10
Trains (Railyard)	0.30	0.17	0.00011	0.024	0.024
Trains (Unloading Siding)	0.40	0.23	0.00015	0.032	0.032
Trucks	0.033	0.017	0.00010	0.00022	0.00022
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.031	0.063
Bulk Material Stockpile (Active Area)	0	0	0	0.57	1.32
TOTAL	**2.16**	**0.54**	**1.05**	**0.76**	**1.54**

* The areas of the stockpiles are 11,250m^2 for wind erosion and 1,125m^2 for the active area. To gain the mass emission rate multiply the emission rate in $g/m^2.s$ by the surface area.

Table 18: Scenario 2 (Concept Plan Operation) Modelling Emissions Inventory

Source	ID	Hour / day	Source Type	No. of Volume Sources	Emission Rate				
					NO_x	CO	SO_2	PM_{10}	TSP
					Emission Rate per Volume Source (g/s)				
Bulk material Berth	VS1	24	Volume	1	1.43	0.12	1.05	0.10	0.10
Bulk Cargo Berth	VS2-3	24	Volume	2	0.72	0.058	0.53	0.050	0.050
Container Berth	VS4-7	24	Volume	4	1.02	0.083	0.75	0.071	0.071
Trains (Railyard)	TR1-3	24	Stack	3*	1.15	0.67	0.00043	0.092	0.092
Trains (Unloading Siding)	TR4-6	24	Volume	3	0.15	0.087	0.000056	0.012	0.012
Trains (Container Terminal)	VS8-15	24	Volume	8	0.17	0.10	0.000065	0.014	0.014
Trucks	VS16-25	24	Volume	10	0.015	0.0075	0.000045	0.00010	0.00010
					Emission Rate per Area Source ($g/m^2.s$)				
Bulk Material Stockpile (Wind Erosion)	OPSSTK	24	Area	NA	0	0	0	0.0000028	0.0000056
Bulk Material Stockpile (Active Area)	ACTSTK	24	Area	NA	0	0	0	0.00025	0.00059

* Trains in the South Yard have been included in the modelling as separated stack sources. To calculate the mass emission rate multiply the pollutant emission rate by the number of stacks.

Table 19: Scenario 2 (Concept Plan Operation) Mass Emission Rates

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk material Berth	1.43	0.12	1.05	0.10	0.10
Bulk Cargo Berth	1.43	0.12	1.05	0.10	0.10
Container Berth	4.10	0.33	3.01	0.29	0.29
Trains (Railyard)	3.46	2.01	0.0013	0.28	0.28
Trains (Unloading Siding)	0.45	0.26	0.00017	0.035	0.035
Trains (Container Terminal)	1.39	0.81	0.00052	0.11	0.11
Trucks	0.15	0.075	0.00045	0.0010	0.0010
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.063	0.13
Bulk Material Stockpile (Active Area)	0	0	0	0.57	1.32
TOTAL	**12.41**	**3.72**	**5.11**	**1.54**	**2.35**

* The areas of the stockpiles are 22,500m^2 for wind erosion and 2,250m^2 for the active area. To gain the mass emission rate multiply the emission rate in g/m^2.s by the surface area.

6.2.3 Source Characteristics

The source characteristics for each of the volume sources are provided in **Table 20**.

Table 20: Modelling Volume Source Characteristics

Sources	Horizontal Spread (m)	Vertical Spread (m)	Centre Height (m)
Dredging Ships	0.5	0.5	10
Cargo Ships	1	1	35
Trains (Construction Stockpile, Multi-purpose Berth and Container Terminal)	47	0.47	3
Trucks	47	0.47	2

The source characteristics for the train stack (point) sources (South Yard trains) are provided in **Table 21**.

Table 21: Modelling Stack Source Characteristics for Trains

Parameter	Value	Units
Release Height	3	Meters
Temperature	200	°C
Stack Diameter	0.3	Meters
Release Velocity	10	m/s

The emission control methods that are directly applied in the modelling are provided below in **Table 22**. The appropriate reduction factors, as provided in the NPI Manual for Mining (Table 3, Commonwealth 2001), have already been applied to those emission rates listed in the above emission rate tables (i.e. the tabulated emission rates are the final values used in the modelling program). The emission reduction factors and their application are also provided in the emissions inventory in **Appendix A**. General mitigation measures that may be appropriate for the development but cannot be included in the modelling are provided in **Table 37** of **Section 8.3**.

Table 22: NPI Reduction Factors Applied in Modelling

Activity	Control Method	Reduction Factor	Applicable Scenario		
			Major Project Construction	Major Project Operation	Concept Plan Operation
Wind erosion from stockpiles	Water sprays	50%	X	X	X
Loading stockpiles	Water sprays	50%	X	X	X
Unloading stockpiles	Water sprays	50%	X	X	X
Wheel generated dust from road haulage	All haul roads sealed	Excluded from modelling	X	X	X

6.3 Comments and Assumptions

The following comments and assumptions have been made in relation to generating the emissions inventory and modelling inputs for the PKOHD AQIA:

General Assumptions

- The modelling is based on the current design for the PKOHD Concept Plan and Major Project as described in chapter 5 and 6 of the environmental assessment document.
- The train and truck line sources (with the exception of the South Yard) were modelled as multiple volume sources spread over the train tracks and haul roads within the PKOHD boundary. The South Yard has been modelled as stack sources, as further described in **Section 6.2**.
- The railyard facility for the PKOHD is being considered for two locations; the northern side of the train loop and the southern side of the train loop. The southern railyard location is closest to sensitive receptors (residents) and as such has been modelled in the AQIA.
- The bulk material and construction stockpiles have been assumed to be at half capacity with this area subject to wind erosion dust emissions. Half capacity has been used to represent to interim nature of such stockpiles. 10% of this half area has been modelled as active in regards to applying loading and unloading dust emissions.
- It has been assumed that bulk material and construction stockpiles will be watered. As such dust emission reductions provided in the NPI manual for mining table 3 (Commonwealth 2001) have been applied to stockpile loading and unloading activities (50% reduction) and for trucks dumping material on stockpiles (50% reduction).
- The following points provide the expected maximum stockpile sizes:
    - Construction fill stockpile during the Major Project Construction period = 30,000m^2
    - Bulk Material stockpile during the Major Project Operations period = 22,500m^2
    - Bulk Material stockpile during the Concept Plan Operations period = 45,000m^2
- It has been assumed in the modelling that at any one time only half the stockpiles will be full of material. As such the stockpile sizes used in the modelling will be half of those provided above.
- It is assumed that demolition and building activities are subject to appropriate routine mitigation measures and any impacts would be short term. As such they have been omitted from the modelling.
- Fill trains for the PKOHD will be unloading material directly into an environmentally controlled trap beneath the rail track, it has been assumed that no pollutant emissions occur as a result of this activity.
- The MAQS emission factors for Heavy Duty diesel fuel engines (trucks) were applied in the modelling (MAQS, 1997a).
- The PM_{10} emission rates from combustion engines (trucks and ships) have been calculated using the NPI manuals (Commonwealth, 2001, 2008a and 2008b). The manuals do not provide emission factors for TSP for these sources, and as such TSP emissions from combustion sources are assumed to be equal to PM_{10} emissions in the AQIA.

- The SO_2 and PM_{10} vehicle emission rates applied in the AQIA provided by the MAQS (EPA 1997a) were based on the total vehicle fleet as individual vehicle types are not detailed. The residential/minor road emission rate category was chosen due to the ports low speed limits.
- Truck movements included in the model were averaged over a 24 hour operating period.
- The height of the bulk and container ship stacks (35m) was based on the typical stack height from the water of the Panamax style cargo ship while berthing in ballast.
- The default NPI values for ship auxiliary power (600kW) and auxiliary boiler fuel consumption (0.0125 tonnes/hour) were applied in the modelling of bulk and container ships.
- The NPI weighted average fuel burn (marine diesel oil and marine gas oil) was applied in the modelling of dredging, bulk and container ships.
- The total hours that ships are moored have been calculated by determining the number of hours a ship is expected to be tied off at each berth per day and the overall time was evenly distributed over the entire day to gain the emission rate for each of the seven berths. This is likely to overestimate the emission rates as the total number of ships accounted for in the model will be greater than that actually present per year. For example, in the Concept Plan modelling the number of ships modelled per year is 2555 which is more than the expected number of 1500 ships per year.
- It has been assumed that ship loading activities are subject to appropriate routine mitigation measures and any impacts would be short term. As such they have been omitted from the modelling.
- A cement facility is to be located within the PKOHD boundary. The facility will be assessed under a separate planning approval process and as such has been omitted from this assessment.**Major Project Construction**Construction activities (including truck haulage, train unloading and stockpile loading) are assumed to be operational 5 days per week (Monday to Friday) for 11 hours per day (7am to 6pm) and 1 day per week (Saturday) for 5 hours per day (8am to 1pm). Dredging operations are assumed to be 24 hours per day, 7 days per week.
- Emission rates were entered into the model using a variable emission rates file to represent the varying operational times of the Major Project construction activities.
- The construction stockpile combustion emissions from train unloading operations were modelled as a line source (separated volume sources) along the western side of the stockpile.
- The following assumptions were made in order to calculate the train fuel consumption for application with the NPI emission equations:
  - 1 train per day with 2 locomotives per train
    - 2 hours per train at the construction stockpile
      - 0.5 hours at throttle 5 (loaded trains)
      - 1 hours at Idle
      - 0.5 hours at throttle 3 (unloaded trains)
  - No trains will be at the bulk material unloading siding or South Yard
  - Train emissions from construction activities were scheduled over a three day rolling time line to represent the various times of the day that the train will be operational. On day 1 the train was modelled operating from 7-10am, day 2 from 11am-2pm, day 3 from 3pm-6pm. No trains were modelled on the seventh day of the week.
- The maximum number of trucks per year during the construction period is estimated to be 71,760 (estimated during the first year of construction). The trucks will travel 1100m (550m one way) within the site per trip.
- It has been estimated that for the construction period one Backhoe Dredger and one Cutter Suction Dredger will be active 24 hours a day, 365 days per year. The dredging ships have been modelled as 1 volume source located in the middle of the dredging area with a vertical dimension of 0.5m, horizontal dimension of 0.5m and height of 10m.
- The emission rates from the dredging ships have been calculated using the NPI manual for Maritime Operations (Commonwealth 2008b).
- The engine capacity of the dredging ships used in the Major Project construction period has been gained from the *Royal Boskalis Westminster N.V* website (http://www.boskalis.com, accessed 22 December 2009). The average capacity of all the listed vessels was used in the assessment.
- The bulk density of the fill material has been assumed to be 1.65 t/m^3. The total throughput during construction is expected to be 3,410,799 m^3 over 8 years, therefore the total tonnes material stockpiled per year is 703,477 tonnes (3,410,799 * 1.65 / 8).

Major Project Operation

- All operation activities are assumed to be 24 hours per day, 7 days per week.
- The following assumptions were made in order to calculate the train fuel consumption for application with the NPI emission equations:
  - 4 trains per day with 2 locomotives per train at the South Yard, consisting of;
    - 4 trains for the multi-purpose berth (bulk freight)
  - 4 trains per day with 2 locomotives per train at the bulk freight berth
- The estimated throttle levels and times for the Major Project Operation are provided in **Section 6.2.** These levels are a current best estimate of the train operations while still retaining a high degree of conservativeness.
- The number of trucks per year during the operations was estimated to be 60,714 travelling 1100m within the site (550m one way) per trip assuming an average of approximately 7 trucks per hour.
- It has been estimated that ships will be moored for an average of 14 hours per day for the bulk material berth. Only one ship berth has been modelled as existing ships at the Gateway Jetty would be included in the measured background concentrations.
- The bulk material stockpile has been modelled as two area sources in the AQIA; total stockpile size for wind erosion and the active section of the stockpile (10% of total) for dust sources from loading/unloading activities.
- The total throughput of bulk material at the port is 4.25 million tonnes per annum. Of this value 1 million tonnes is enclosed clinker material and a further 800,000 tonnes consists of a combination of bulk liquids, bulk solids stored in sheds or under tarps prior to export, and imported bulk solids discharged directly to trucks and transported from the site. The total throughput to be place on exposed stockpiles on site is therefore 2.45 million tonnes per year.

Concept Plan Operation

- All operation activities are assumed to be 24 hours per day, 7 days per week.
- The following assumptions were made in order to calculate the train fuel consumption for application with the NPI emission equations:
  - 21 trains at the South Yard per day, consisting of:
    - 5 trains for the multi-purpose berth (4 bulk, 1 general)
    - 16 trains for the Container Berth
  - 5 trains at multi-purpose berth (4 bulk, 1 general)
  - 16 trains at Container Berth
- The estimated throttle levels and times for the Concept Plan operations are provided in **Section 6.2.** These levels are a current best estimate of the train operations while still retaining a high degree of conservativeness.
- South YardSouth YardThe number of trucks per year during the operations was estimated to be 184,714 travelling 1600m within the site (800m one way) on site per trip assuming an average of 21 trucks per hour.
- It has been estimated that ships will be moored for an average of 14 hours per day for the bulk material berth, 7 hours per day for the bulk cargo berths and 10 hours per day for the container berths. These values have been used in conjunction with the NPI emission factors to calculate the vessel emission rates.
- The model has assumed seven ships will be at berth per day for 365 days per year. The number of ships modelled per year is therefore 2555 which is more than the expected number of 1500 ships per year. This will result in conservative impacts from ship emissions in the Concept Plan modelling.
- The bulk material stockpile has been modelled as two area sources in the AQIA; total stockpile size for wind erosion and the active section of the stockpile (10% of total) for dust sources from loading/unloading activities.
- The total throughput of material at the port is 4.25 million tonnes per annum. Of this value 1 million tonnes is enclosed clinker material and a further 800,000 tonnes consists of a combination of bulk liquids, bulk solids stored in sheds or under tarps prior to export, and imported bulk solids discharged directly to trucks and transported from the site. The total throughput to be place on exposed stockpiles on site is therefore 2.45 million tonnes per year.

6.4 Existing Air Quality

A detailed description of the existing air quality in the local area has been provided in **Section 4.0**. A summary of the pollutant data sourced from the DECCW Wollongong monitoring station which has been applied as the background concentration in the modelling is presented in **Table 23.** The maximum measured pollutant 1 hour, 8 hour and 24 hour values for 2003 to 2007 and annual averages for 2003 to 2007 have been used in the modelling. Background values below 1 hour were not available. Note that oxides of nitrogen have not been included in the table. The application of oxides of nitrogen background values has been discussed below.

The Wollongong DECCW monitoring station does not measure TSP. To allow an estimation of likely TSP background values, the TSP concentrations were calculated from the measured PM_{10} annual average using a typical ambient PM_{10} to TSP ratio of 39% i.e. 39% of TSP is PM_{10} (NSW Minerals Council, 2000).

Table 23: Background Pollutant Concentrations

Pollutant	Averaging Period	Background Value (ug/m^3)	Criteria (ug/m^3)
CO	1 Hour	4,250	30,000
	8 Hour	3,250	10,000
SO_2	1 Hour	152	570
	24 Hour	43	228
	Annual	3	60
PM_{10}*	24 Hour	62	50
	Annual	19	30
TSP**	Annual	49	90

* PM_{10} data derived from TEOM measurements.

** TSP has been calculated from the Annual PM_{10} value using a PM_{10} to TSP ratio of 39% (NSW Minerals Council, 2000).

Nitrogen oxides are produced in most combustion processes and are formed during the oxidation of nitrogen in fuel and nitrogen in the air. During high-temperature processes a variety of oxides are formed including nitric oxide (NO) and Nitrogen dioxide NO_2. Generally, at the point of emission NO will comprise the greatest proportion of the emission with 95% by volume of the NO_x. The remaining NO_x will consist of NO_2. Ultimately, however, all nitric oxides emitted into the atmosphere are oxidised to NO_2 and then further to other higher oxides of nitrogen.

The USEPA's Ozone Limiting Method (OLM) has been used to predict ground-level concentrations of NO_2. The OLM is based on the assumption that approximately 10% of the initial stack NO_X emissions are emitted as NO_2. If the ozone (O_3) concentration is greater than 90% of the predicted NO_X concentrations, all the NO_X is assumed to be converted to NO_2, otherwise NO_2 concentrations are predicted using the equation $NO_2 = 46/48 * O_3 + 0.1 * NO_X$. This method assumes instant conversion of NO to NO_2 in the plume, which overestimates concentrations close to the source since conversion usually occurs over periods of hours. This method is described in detail in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW DEC, 2005).

Contemporaneous (hourly average) O_3 and background NO_2 data from the Wollongong DECCW Monitoring Station were used in the conversion to produce background NO_2 concentrations which have been examined further in the AQIA.

As the 24 hour average PM_{10} background concentration exceeded the DECCW criteria, an alternative method was required to assess the potential fine particulate impacts. The DECCW Approved Methods (DEC, 2005) states that where existing ambient air pollutant concentrations exceed impact assessment criteria "*a licensee must demonstrate that no additional exceedences of the impact assessment criteria will occur as a result of the proposed activity*". PM_{10} emissions have been modelled contemporaneously with background PM_{10} concentrations and the number of exceedences of the criteria calculated over the modelling period. An assessment of whether any additional exceedences have occurred was undertaken.

6.5 Sensitive Receptors

The AUSPLUME modelling domain incorporates a 5 km by 5 km grid with a resolution of 0.1 km, centred over the PKOHD. Within this gridded modelling domain, discrete sensitive receptors were modelled. The DECCW considers sensitive receptors to be areas where people are likely to either live or work, or engage in recreational activities (DEC, 2005). On this basis, representative sensitive receptors were selected at 10 locations surrounding the site. The receptors were chosen from local residential and commercial buildings. Industrial buildings were not chosen as these locations are less sensitive to industrial emissions. However, these locations will still be assessed using the Ground Level Concentration (GLC) contours produced in the modelling.

A summary of the approximate sensitive receptor locations is provided below in **Table 24** and shown in **Figures F8-F10**.

Table 24: Sensitive Receptor Locations

Receptor Number	Sensitive Receptor Description	Type
1	Flagstaff Rd, west of PKOHD	Commercial
2	Five Island Rd, west south west of PKOHD	Commercial
3	Five Island Rd, south west of PKOHD	Residential
4	Military Rd, south of PKOHD	Commercial
5	Military Rd, south of PKOHD	Residential
6	Marne St, south of PKOHD	Residential
7	First Ave, south of PKOHD	Residential
8	Church St, south of PKOHD	Residential
9	Keira St, south west of PKOHD	Residential
10	Holman St, west south west of PKOHD	Residential

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7.0 Air Dispersion Modelling Results

7.1 Overview

The predicted pollutant GLCs for each scenario gained from the dispersion modelling are provided in the following sections. The modelling is a representation of the developments peak operating capacity (commonly referred to as worst case operations). This assumes that all operations at the site are operating at their planned peak values all the time, which also includes conservative estimates of operating times (such as maximum train throttle times). In reality, this peak capacity operating situation is only likely to occur for a minimum amount of time, if at all. As requested by DoP a review of the 'peak operating capacity' against the predicted 'normal operations' of the Concept Plan has been provided in **Appendix C**.

Where appropriate, predicted pollutant GLC contours have been plotted and are provided in **Figures F8 – F10**. The contour figures are a graphical representation of the predicted maximum pollutant GLCs measured at each of the gridded receptor nodes (100m spacing over a 5km by 5km grid) over the full modelling time period under all expected meteorological condition. Contours are determined by interpolation between the modelled grid nodes and as such should be considered as indicative values produced for visual purposes only.

PM_{10} and NO_x emissions have been assessed on a contemporaneous basis in accordance with the DECCW Approved Methods (DEC, 2005) for a level 2 assessment. The Approved Methods allow for pollutant emissions to be modelled during the same hourly time period as the measured background concentration i.e. add the first hourly average dispersion model prediction to the first hourly average background concentration and so on. This allows a cumulative assessment of the predicted impacts and the background in relation to the time of year the release occurs i.e. predictions and background concentrations are paired in time. Assessing the total predicted ground level concentrations using a contemporaneous approach provides a more realistic estimation of the likely actual GLCs.

7.2 Scenario 1a Results (Major Project Construction)

The predicted Scenario 1a pollutant GLCs are provided in **Table 25**, **Table 26** and **Table 27**. Where background data is available, the predicted cumulative pollutant GLCs (predicted GLC plus the background concentration) are shown in brackets. For PM_{10} and NO_x results, the additional number of exceedences beyond that already measured in the background data have been listed in square brackets. Note that deposited dust results are expressed as deposition rates and not concentrations.

Table 25: Scenario 1a (Major Project Construction) Maximum Predicted GLC at the Discrete Sensitive Receptors for PM_{10}, TSP and Dust Deposition

Receptor Number	PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust Deposition (g/m^2.month)
	24 Hour	Annual	Annual	Annual
1	2 (**64**) [0]	0.1 (21)	0.1 (49.1)	0.01
2	2 (**63**) [1]	0.2 (21)	0.3 (49.3)	0.02
3	8 (**64**) [2]	0.8 (22)	1.2 (50.2)	0.13
4	7 (**66**) [2]	0.7 (22)	1.1 (50.1)	0.07
5	5 (**66**) [1]	0.5 (21)	0.7 (49.7)	0.03
6	5 (**65**) [0]	0.4 (21)	0.5 (49.5)	0.01
7	3 (**64**) [0]	0.3 (21)	0.4 (49.4)	0.01
8	4 (**65**) [0]	0.4 (21)	0.6 (49.6)	0.03
9	3 (**64**) [1]	0.4 (21)	0.6 (49.6)	0.06
10	2 (**63**) [1]	0.2 (21)	0.2 (49.2)	0.02
Criteria	50	30	90	2

Bold denotes exceedences of criteria

Table 26: Scenario 1a (Major Project Construction) Maximum Predicted GLC at the Discrete Sensitive Receptors for NO_2 and SO_2

Receptor Number	Nitrogen Dioxide (NO_2) ($\mu g/m^3$)		Sulfur Dioxide (SO_2) ($\mu g/m^3$)			
	1 Hour	Annual	10 min	1 hour	24 hour	Annual
1	103 (115)	1 (19)	31	22 (174)	2 (45)	0.1 (3.1)
2	164 (185)	2 (20)	44	30 (182)	2 (45)	0.1 (3.1)
3	191 (**253**) [1]	5 (23)	83	59 (211)	6 (49)	0.4 (3.4)
4	173 (195)	3 (21)	66	46 (198)	5 (48)	0.4 (3.4)
5	145 (178)	3 (21)	54	38 (190)	4 (47)	0.4 (3.4)
6	125 (156)	2 (20)	49	35 (187)	4 (47)	0.3 (3.3)
7	96 (135)	2 (20)	39	27 (179)	2 (45)	0.2 (3.2)
8	127 (148)	2 (20)	44	31 (183)	3 (46)	0.3 (3.3)
9	116 (165)	3 (21)	47	33 (185)	2 (45)	0.2 (3.2)
10	106 (126)	1 (19)	33	23 (175)	2 (45)	0.1 (3.1)
Criteria	246	62	712	570	228	60

Bold denotes exceedences of criteria

Table 27: Scenario 1a (Major Project Construction) Maximum Predicted GLC at the Discrete Sensitive Receptors for CO

Receptor Number	Carbon Monoxide (CO) ($\mu g/m^3$)		
	15 Minutes	1 hour	8 Hours
1	19	15 (4,265)	3 (3,253)
2	27	21 (4,271)	4 (3,254)
3	52	40 (4,290)	11 (3,261)
4	41	31 (4,281)	7 (3,257)
5	34	26 (4,276)	7 (3,257)
6	31	24 (4,274)	5 (3,255)
7	24	19 (4,269)	4 (3,254)
8	28	21 (4,271)	4 (3,254)
9	30	23 (4,273)	4 (3,254)
10	21	16 (4,266)	4 (3,254)
Criteria	100,000	30,000	10,000

Bold denotes exceedences of criteria

The modelling results show that with the exception of PM_{10} 24 hour average and NO_2 1 hour average time periods, all selected pollutants met the DECCW criteria at the discrete sensitive receptors. **Figure F8** presents the PM_{10} 24 hour average results (in isolation from background) as contour plots. NO_2 1 hour contours cannot be generated due to the conversion of NO_x to NO_2 using the DECCW OLM method.

The predicted 24 hour PM_{10} GLCs show that there are likely to be exceedences in addition to the number of exceedences that already occur in the Wollongong air shed. There were no exceedances of the PM_{10} annual average criteria for the cumulative results. Based on the mass emission rates provided in **Table 15**, the likely main source of dust contribution is the active area of the construction stockpile i.e. material handling activities.

Table 28 presents the meteorological conditions for the top five maximum predicted 24 hour PM_{10} GLCs at the discrete sensitive receptors. The data shows maximum concentrations during mild winds (~ 2-3 m/s), with a slight trend towards winds from a north-east direction and occurring between October and January.

The modelling predicted that the NO_2 1 hour criteria would be exceeded at only one of the sensitive receptor locations (Receptor No. 3) when considered cumulatively with background NO_2 concentrations. The NEPM for Ambient Air Quality (Commonwealth, 2003) provides the goal for the maximum allowable days of exceedence for NO_2 as one day per year. For the receptor where there is predicted to be an exceedence of the criteria, there is only one hour out of the year where the concentration exceeds the limit, which is less than the allowable 24 hours (one day as listed in the NEPM). The desired environmental outcome of the Air NEPM is ambient air quality that provides for the adequate protection of human health and wellbeing and is considered as a good guideline for long term health impacts. On this basis the long term impacts of Scenario 1a (Major Project: Construction) are not expected to be adverse.

Scenario 1a includes the simultaneous operation of all expected construction activities at the port. Activities such as train and truck movements and dredging activities are likely to be of an intermittent nature, and together with equipment ‘down-time’ caused by maintenance, shift breaks, public holidays etc, it is considered unlikely that all construction activities would occur simultaneously during the worst case meteorological conditions required to cause the modelled maximum predicted GLCs. The predicted maximum GLCs are therefore considered conservative and the likely impact that Scenario 1a will have on the local community is expected to be less than that predicted in the modelling.

Table 28: Scenario 1a (Major Project Construction) Meteorological Conditions for Top 5 Maximum Predicted Cumulative PM_{10} GLCs at the Discrete Sensitive Receptors

Receptor 1				Receptor 2				Receptor 3				Receptor 4			
Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS
	μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s
1/12/2006	64	49	2.0	1/12/2006	63	49	2.0	1/12/2006	64	49	2.0	1/12/2006	66	49	2.0
21/11/2006	60	12	2.0	21/11/2006	61	12	2.0	21/11/2006	61	12	2.0	21/11/2006	61	12	2.0
22/11/2006	59	278	3.9	22/11/2006	59	278	3.9	22/11/2006	59	278	3.9	22/11/2006	59	278	3.9
20/01/2007	52	44	2.2	20/01/2007	53	44	2.2	20/01/2007	59	44	2.2	20/01/2007	54	44	2.2
8/10/2006	51	192	3.3	8/10/2006	51	192	3.3	23/12/2006	54	148	1.1	8/10/2006	52	192	3.3

Receptor 5				Receptor 6				Receptor 7				Receptor 8			
Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS
	μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s
1/12/2006	66	49	2.0	1/12/2006	65	49	2.0	1/12/2006	64	49	2.0	1/12/2006	65	49	2.0
21/11/2006	60	12	2.0	21/11/2006	60	12	2.0	21/11/2006	60	12	2.0	21/11/2006	61	12	2.0
22/11/2006	59	278	3.9	22/11/2006	60	278	3.9	22/11/2006	59	278	3.9	22/11/2006	59	278	3.9
20/01/2007	56	44	2.2	20/01/2007	53	44	2.2	20/01/2007	53	44	2.2	20/01/2007	53	44	2.2
8/10/2006	52	192	3.3	21/01/2007	52	64	1.8	21/01/2007	52	64	1.8	8/10/2006	52	192	3.3

Receptor 9				Receptor 10			
Date	Conc.	WD	WS	Date	Conc.	WD	WS
	μg/m^3	Deg.	m/s		μg/m^3	Deg.	m/s
1/12/2006	64	49	2.0	1/12/2006	63	49	2.0
21/11/2006	61	12	2.0	21/11/2006	61	12	2.0
22/11/2006	59	278	3.9	22/11/2006	59	278	3.9
20/01/2007	54	44	2.2	20/01/2007	54	44	2.2
8/10/2006	52	192	3.3	21/01/2007	52	64	1.8

Conc. – PM_{10} cumulative GLC (predicted GLC plus background concentration)
Deg. – Wind direction in degrees
m/s – Wind Speed in meters per second
WD – Wind Direction
WS – Wind Speed

7.3 Scenario 1b Results (Major Project; Operation)

The predicted Scenario 1b pollutant GLCs are provided in **Table 29**, **Table 30** and **Table 31**. Where background data is available, the predicted cumulative pollutant GLCs (predicted GLC plus the background concentration) are provided in brackets. For PM_{10} results, the additional number of exceedences beyond that already measured in the background data have also been listed in square brackets. Note that deposited dust results are expressed as deposition rates and not concentrations.

Table 29: Scenario 1b (Major Project Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for PM_{10}, TSP and Dust Deposition

Receptor Number	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust Deposition (g/m^2.month)
	24 Hour	Annual	Annual	Annual
1	12 (64) [2]	0.5 (21)	1.2 (50.2)	0.08
2	23 (72) [6]	1.4 (22)	3 (52)	0.18
3	37 (69) [11]	3.8 (25)	8.4 (57.4)	0.37
4	25 (73) [3]	2.5 (23)	5.7 (54.7)	0.17
5	23 (70) [1]	1.8 (23)	4 (53)	0.11
6	14 (65) [1]	1.2 (22)	2.7 (51.7)	0.08
7	18 (68) [0]	1.2 (22)	2.6 (51.6)	0.07
8	18 (72) [2]	1.8 (23)	4 (53)	0.12
9	19 (66) [2]	1.9 (23)	4.2 (53.2)	0.17
10	21 (67) [5]	1.1 (22)	2.5 (51.5)	0.14
Criteria	50	30	90	2

Bold denotes exceedences of criteria

Table 30: Scenario 1b (Major Project Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for NO_2 and SO_2

Receptor Number	Nitrogen Dioxide (NO_2) ($\mu g/m^3$)		Sulfur Dioxide (SO2) ($\mu g/m^3$)			
	1 Hour	Annual	10min	1 hour	24 hour	Annual
1	53 (84)	0.4 (18)	40	28 (180)	2.4 (45.4)	0.2 (3.2)
2	57 (90)	1.1 (19)	59	44 (196)	3.4 (46.4)	0.3 (3.3)
3	73 (102)	2 (20)	75	56 (208)	3.5 (46.5)	0.6 (3.6)
4	50 (91)	1 (19)	52	45 (197)	4 (47)	0.5 (3.5)
5	48 (89)	0.8 (19)	61	49 (201)	3.6 (46.6)	0.4 (3.4)
6	38 (87)	0.5 (18)	74	52 (204)	4.2 (47.2)	0.3 (3.3)
7	37 (88)	0.5 (18)	66	46 (198)	3.6 (46.6)	0.3 (3.3)
8	47 (90)	0.9 (19)	50	39 (191)	3.4 (46.4)	0.4 (3.4)
9	60 (89)	1.3 (19)	51	39 (191)	3.1 (46.1)	0.4 (3.4)
10	50 (95)	0.8 (19)	54	39 (191)	3.8 (46.8)	0.3 (3.3)
Criteria	246	62	712	570	228	60

Bold denotes exceedences of criteria

Table 31: Scenario 1b (Major Project Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for CO

Receptor Number	Carbon Monoxide (CO) ($\mu g/m^3$)		
	15 Minutes	1 hour	8 Hours
1	59	46 (4296)	12 (3262)
2	82	63 (4313)	19 (3269)
3	150	115 (4365)	26 (3276)
4	80	61 (4311)	14 (3264)
5	60	46 (4296)	10 (3260)
6	51	39 (4289)	9 (3259)
7	42	32 (4282)	8 (3258)
8	53	41 (4291)	9 (3259)
9	69	53 (4303)	13 (3263)
10	60	50 (4300)	21 (3271)
Criteria	100,000	30,000	10,000

Bold denotes exceedences of criteria

The modelling results show that with the exception of PM_{10} 24 hour average, all modelled pollutants met the DECCW criteria at the discrete sensitive receptors. **Figure F9** presents the PM_{10} 24 hour average results (in isolation from background) as contour plots.

The predicted be 24 hour PM_{10} GLCs show that there are likely to be exceedences in addition to the number of exceedences that already occur in the Wollongong air shed for all sensitive receptors. There were no exceedences of the PM_{10} annual average assessment criteria. Based on the mass emission rates provided in **Table 17**, the likely main source of dust contribution is the active area of the bulk material stockpile i.e. material handling activities.

Table 32 presents the meteorological conditions for the top five maximum predicted PM_{10} GLCs at the discrete sensitive receptors. The data shows maximum concentrations generally during mild winds (~ 2-3 m/s), with a trend towards winds from a north-east direction and occurring generally between November and January (although some top 5 results were present in February, May and September).

The Major Project operations modelling scenario is considered to be the peak operational capacity and is likely to result in conservative estimate of likely impact. It is assumed in the modelling that the all of the Major Project operational activities will be simultaneously active 24 hours a day for 365 days of the year. This includes the simultaneous operation of the expected daily maximum number of trucks, trains and ships at the port. Activities such as train, truck and ship movements are likely to be of an intermittent nature, and together with equipment 'down-time' caused by maintenance, shift breaks, public holidays etc, it is considered unlikely that all activities would occur simultaneously during the worst case meteorological conditions required to cause the modelled maximum predicted GLCs. The predicted maximum GLCs are therefore considered conservative and the likely impact that Scenario 1b will have on the local community is expected to be less than that predicted in the modelling.

Table 32: Scenario 1b (Major Project Operation) Meteorological Conditions for Top 5 Maximum Predicted Cumulative PM_{10} GLCs at the Discrete Sensitive Receptors

Receptor 1				Receptor 2				Receptor 3				Receptor 4			
Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s
1/12/2006	67	50	2.0	20/01/2007	73	43	2.2	14/12/2006	86	42	2.2	20/01/2007	82	43	2.2
21/11/2006	61	4	2.0	23/12/2006	70	137	1.2	17/05/2007	82	355	1.1	1/12/2006	78	50	2.0
22/11/2006	59	280	3.9	1/12/2006	66	50	2.0	22/12/2006	80	37	3.2	30/01/2007	70	28	2.3
20/01/2007	53	43	2.2	21/11/2006	62	4	2.0	20/01/2007	78	43	2.2	17/01/2007	68	28	2.4
8/10/2006	52	190	3.3	21/01/2007	60	59	1.8	21/01/2007	76	59	1.8	21/01/2007	64	59	1.8

Receptor 5				Receptor 6				Receptor 7				Receptor 8			
Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s
1/12/2006	73	50	2.0	1/12/2006	66	50	2.0	1/12/2006	69	50	2.0	1/12/2006	76	50	2.0
20/01/2007	68	43	2.2	21/11/2006	61	4	2.0	21/11/2006	61	4	2.0	20/01/2007	73	43	2.2
21/01/2007	62	59	1.8	22/11/2006	60	280	3.9	20/01/2007	60	43	2.2	30/01/2007	67	28	2.3
21/11/2006	61	4	2.0	20/01/2007	56	43	2.2	22/11/2006	60	280	3.9	21/11/2006	61	4	2.0
22/11/2006	60	280	3.9	11/01/2007	53	21	2.1	21/01/2007	55	59	1.8	22/11/2006	60	280	3.9

Receptor 9				Receptor 10			
Date	Conc. µg/m^3	WD Deg.	WS m/s	Date	Conc. µg/m^3	WD Deg.	WS m/s
18/11/2006	20	359	2.1	20/01/2007	74	43	2.2
14/11/2006	19	358	2.2	21/01/2007	69	59	1.8
16/02/2007	27	356	1.9	23/12/2006	67	137	1.2
18/09/2006	38	355	1.2	1/12/2006	65	50	2.0
17/05/2007	53	355	1.1	7/01/2007	63	34	2.0

Conc. – PM_{10} cumulative GLC (predicted GLC plus background concentration)
Deg. – Wind direction in degrees
m/s – Wind Speed in meters per second
WD – Wind Direction
WS – Wind Speed

7.4 Scenario 2 Results (Concept Plan Operation)

The predicted Scenario 2 pollutant GLCs are provided in **Table 33**, **Table 34** and **Table 35**. Where background data are available, the predicted cumulative pollutant GLCs (predicted GLC plus the background concentration) are provided in brackets. For 24 hour PM_{10} results the additional number of exceedences beyond that already measured in the background data have been provided in square brackets. Note that deposited dust results are expressed as deposition rates and not concentrations.

Table 33: Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for PM_{10}, TSP and Dust Deposition

Receptor Number	PM_{10} (µg/m^3)		TSP (µg/m^3)	Dust Deposition (g/m^2.month)
	24 Hour	Annual	Annual	Annual
1	16 (**67**) [1]	0.6 (21)	1.2 (50.2)	0.07
2	22 (**73**) [9]	1.8 (23)	3.4 (52.4)	0.20
3	**57** (**86**) [24]	6.3 (27)	13.4 (62.4)	0.68
4	37 (**82**) [8]	4.1 (25)	8.8 (57.8)	0.25
5	34 (**73**) [3]	2.8 (24)	5.9 (54.9)	0.16
6	18 (**66**) [3]	1.9 (23)	3.7 (52.7)	0.10
7	23 (**69**) [0]	1.8 (23)	3.6 (52.6)	0.09
8	24 (**76**) [4]	2.8 (24)	5.8 (54.8)	0.16
9	28 (**69**) [7]	3.1 (24)	6.1 (55.1)	0.25
10	23 (**74**) [6]	1.6 (22)	3.0 (52.0)	0.16
Criteria	50	30	90	2

Bold denotes exceedences of criteria

Table 34: Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for NO_2 and SO_2

Receptor Number	Nitrogen Dioxide (NO_2) (µg/m^3)		Sulfur Dioxide (SO2) (µg/m^3)			
	1 Hour	Annual	10min	1 hour	24 hour	Annual
1	88 (132)	2 (20)	126	108 (260)	8.8 (51.8)	0.7 (3.7)
2	98 (121)	5 (23)	177	155 (307)	13.3 (56.3)	1.2 (4.2)
3	98 (115)	7 (25)	233	200 (352)	16.4 (59.4)	2.7 (5.7)
4	90 (113)	4 (22)	200	183 (335)	13.5 (56.5)	2.5 (5.5)
5	85 (112)	3 (21)	197	174 (326)	16.7 (59.7)	2.2 (5.2)
6	79 (116)	3 (21)	252	216 (368)	19.0 (62.0)	1.9 (4.9)
7	78 (110)	3 (20)	213	181 (333)	17.2 (60.2)	1.7 (4.7)
8	88 (112)	3 (21)	183	162 (314)	12.3 (55.3)	1.9 (4.9)
9	89 (114)	5 (23)	163	144 (296)	12.2 (55.2)	1.9 (4.9)
10	113 (136)	4 (22)	175	139 (291)	12.6 (55.6)	1.1 (4.1)
Criteria	246	62	712	570	228	60

Bold denotes exceedences of criteria

Table 35: Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for CO

Receptor Number	Carbon Monoxide (CO) ($\mu g/m^3$)		
	15 Minutes	1 hour	8 Hours
1	262	206 (4456)	52 (3302)
2	291	237 (4487)	78 (3328)
3	279	213 (4463)	58 (3308)
4	261	199 (4449)	52 (3302)
5	244	186 (4436)	49 (3299)
6	215	164 (4414)	49 (3299)
7	204	156 (4406)	42 (3292)
8	244	186 (4436)	45 (3295)
9	253	201 (4451)	79 (3329)
10	293	244 (4494)	94 (3344)
Criteria	100,000	30,000	10,000

Bold denotes exceedences of criteria

The modelling results show that with the exception of 24 hour average PM_{10}, all modelled pollutants met the DECCW criteria at the discrete sensitive receptors.

The predicted PM_{10} GLCs show that there are likely to be exceedences in addition to the number of exceedences that already occur in the Wollongong air shed. There were no exceedences of the PM_{10} annual average criteria. Based on the mass emission rates provided in **Table 20**, the likely main source of dust contribution is the active area of the bulk material stockpile i.e. material handling activities. **Figure F10** presents the PM_{10} 24 hour average results (in isolation from background) as contour plots.

Table 36 presents the meteorological conditions for the top five maximum predicted PM_{10} GLCs at the discrete sensitive receptors. The data shows maximum concentrations during mild winds (~ 2-3 m/s), with a slight trend towards winds from a north-east direction and occurring generally between November and January (although some top 5 results were present in February, May and September).

The Concept Plan operations modelling scenario is considered to be the peak operational capacity and is likely to result in conservative estimate of likely impacts. It is assumed in the modelling that the all of the Concept Plan operations will be simultaneously active 24 hours a day for 365 days of the year. The scenario includes the simultaneous operation of the expected daily maximum number of trucks, trains and ships at the port. Activities such as train, truck and ship movements are likely to be of an intermittent nature, and together with equipment 'down-time' caused by maintenance, shift breaks, public holidays etc, it is considered unlikely that all activities would occur simultaneously during the worst case meteorological conditions required to cause the modelled maximum predicted GLCs. The predicted maximum GLCs are therefore considered conservative and the likely impact that Scenario 2 will have on the local community is expected to be less than that predicted in the modelling.

Table 36: Scenario 2 (Concept Plan Operation) Meteorological Conditions for Top 5 Maximum Predicted Cumulative PM_{10} GLCs at the Discrete Sensitive Receptors

Receptor 1				Receptor 2				Receptor 3				Receptor 4			
Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS
	µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s
1/12/2006	67	50	2.0	20/01/2007	73	43	2.2	14/12/2006	86	42	2.2	20/01/2007	82	43	2.2
21/11/2006	61	4	2.0	23/12/2006	70	137	1.2	17/05/2007	82	355	1.1	1/12/2006	78	50	2.0
22/11/2006	59	280	3.9	1/12/2006	66	50	2.0	22/12/2006	80	37	3.2	30/01/2007	70	28	2.3
20/01/2007	53	43	2.2	21/11/2006	62	4	2.0	20/01/2007	78	43	2.2	17/01/2007	68	28	2.4
8/10/2006	52	190	3.3	21/01/2007	60	59	1.8	21/01/2007	76	59	1.8	21/01/2007	64	59	1.8

Receptor 5				Receptor 6				Receptor 7				Receptor 8			
Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS	Date	Conc.	WD	WS
	µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s
1/12/2006	73	50	2.0	1/12/2006	66	50	2.0	1/12/2006	69	50	2.0	1/12/2006	76	50	2.0
20/01/2007	68	43	2.2	21/11/2006	61	4	2.0	21/11/2006	61	4	2.0	20/01/2007	73	43	2.2
21/01/2007	62	59	1.8	22/11/2006	60	280	3.9	20/01/2007	60	43	2.2	30/01/2007	67	28	2.3
21/11/2006	61	4	2.0	20/01/2007	56	43	2.2	22/11/2006	60	280	3.9	21/11/2006	61	4	2.0
22/11/2006	60	280	3.9	11/01/2007	53	21	2.1	21/01/2007	55	59	1.8	22/11/2006	60	280	3.9

Receptor 9				Receptor 10			
Date	Conc.	WD	WS	Date	Conc.	WD	WS
	µg/m^3	Deg.	m/s		µg/m^3	Deg.	m/s
18/11/2006	20	359	2.1	20/01/2007	74	43	2.2
14/11/2006	19	358	2.2	21/01/2007	69	59	1.8
16/02/2007	27	356	1.9	23/12/2006	67	137	1.2
18/09/2006	38	355	1.2	1/12/2006	65	50	2.0
17/05/2007	53	355	1.1	7/01/2007	63	34	2.0

Conc. – PM_{10} cumulative GLC (predicted GLC plus background concentration)
Deg. – Wind direction in degrees
m/s – Wind Speed in meters per second
WD – Wind Direction
WS – Wind Speed

7.5 Limitations of Dispersion Modelling

The efficiency of pollution abatement equipment for vehicle exhausts and fuel standards is the object of ongoing research and improvement. The NPI values used in the AQIA are several years old and are not likely to accurately reflect current efficiency levels. As time goes on and new technologies become available, actual emission rates are likely to reduce further below those predicted in the AQIA. This is particularly relevant given the timeframe for implementation of the Concept Plan. The exhaust emission factors applied in the AQIA are therefore considered conservative.

The dredging ship emissions (in particular NO_x) considered in the modelling is likely to be an overestimate due to increasing abatement efficiency levels. Modern dredging ships typically have a catalytic convertor system to mitigate exhaust pollutions, with efficiency generally greater than 85%. The NPI emission factor for ship emissions used in the AQIA may not accurately reflect exhaust emissions using a catalytic convertor from the dredging ships and is therefore likely to overestimate the actual impacts.

Best efforts have been made to estimate the likely numbers and operational parameters (including fuel type and consumption etc) of ships and trucks in the AQIA. The numbers used have been based on current information and may change to reflect the detailed design of the PKOHD. The numbers used in the model are considered as conservative and as such any minor changes in the future are not likely to have a significant impact on the modelling results. If major changes are proposed in regards to pollutant emitting activities during construction or operation, then further modelling of the project incorporating these changes may be required.

Air dispersion modelling of train and ship emissions has not been historically undertaken in Australia. Best efforts have been made to approach the modelling in a reasonable and realistic way, however there is likely to be a degree of uncertainty in the results. Train and ship operational details are limited and conservative assumptions have been applied during the modelling. These conservative assumptions, such as modelling ship emissions as volume sources instead of stack sources, are likely to overestimate the pollutant impacts of the PKOHD on the local community.

Future project applications will be required for Stages 2 and 3 and further air quality assessments may be required during these stages to identify worst case air pollution scenarios and pollutant impact hot spots.

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8.0 Discussion and Mitigation Measures

8.1 Discussion of Results

The qualitative analysis of the regional air shed using existing (background) pollution data shows that with the exception of short term episodic particulate matter, there is the capacity to increase the pollutants of concern in the air shed without exceeding relevant criteria (short term concentrations of PM_{10} and to a lesser extent NO_2 can on occasion exceed the assessment criteria). The analysis has shown that there may be a constraint on those operations that have the potential to emit fine particulates in the air shed during the construction and operation phases.

The meteorological data suggests that the emission of pollutants during night time may have a higher impact on the surrounding area when the winds are more stable and hence there is less dispersion of pollutants. Future operations of the multi-purpose and container terminal which form part of later stages of the Concept Plan will have to consider this night time affect when planning developments, particularly in relation to particulate emissions.

The results from the dispersion modelling are discussed below:

Major Project (Stage 1) Construction

The modelling results for the construction suggest that the NO_2 GLCs from the PKOHD are likely to exceed criteria for one discrete receptor (Receptor No. 3). The exceedence at the single receptor was for one hour during the full year and as such meets the NEPM criteria for days allowed above the assessment criteria. Construction activities would be expected to only cause short term, localised increases in pollutants. Due to the conservativeness of the modelling approach it is expected that the actual NO_2 impacts of the PKOHD will be less than that predicted by the modelling. Monitoring of ambient NO_2 levels may be required during construction and an appropriate Air Quality Management Plan (AQMP) should be prepared or updated based on these results. The AQMP should be integrated into the site Construction Environmental Management Plan (CEMP).

The modelling results suggest that the construction has the potential to increase short term (24 hour average) PM_{10} emissions from construction stockpiles and the increase in trains and trucks during construction. Long term PM_{10} predictions (annual average) suggest that the assessment criteria will be met at all receptors. The impacts of the construction phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP. Mitigation measures that may be applied to Major Project construction activities are discussed in **Section 8.3**.

Major Project (Stage 1) Operation

The modelling results for the operation suggest that the operation has the potential to increase short term (24 hour average) PM_{10} emissions from material stockpiles and an increase in trains, trucks and ships. Long term PM_{10} predictions (annual average) were predicted to meet the criteria. The impacts of the operation phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP. Mitigation measures that may be applied to the Major Project operation activities are discussed in **Section 8.3**.

Concept Plan Operation

The modelling results for the Concept Plan suggest that the operation has the potential to increase short term (24 hour average) PM_{10} emissions from material stockpiles and an increase in trains, trucks and ships. Long term PM_{10} predictions (annual average) were predicted to meet the assessment criteria. The impacts of the operation phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP. Mitigation measures that may be applied to the Concept Plan operation activities are discussed in **Section 8.3**.

8.2 Discussion of Blast Furnace Slag

Comments were received from DECCW during the public submissions period which questioned whether dust from the blast furnace slag (which is proposed to be used for fill as part of the reclamation area for the Outer Harbour development) posed a human health risk to sensitive receptors surrounding the port.

AECOM found that there is limited available information on the concentrations of heavy metals in dust generated from blast furnace slag. As a result AECOM has assessed a scenario assuming that the concentrations of heavy metals in slag dust are equivalent to the maximum average concentrations for characterisation as described in the DECCW resource recovery exemption for blast furnace slag. These concentrations have been multiplied by the maximum hourly average TSP GLC modelled for construction activities involving slag. The results of the screening assessment are provided in **Appendix F**. Note that there are no data or DECCW assessment criteria for Boron.

This screening assessment suggests that all of the metals potentially present in the blast furnace slag meet the one hour maximum and annual concentration under the DECCW assessment criteria.

It should be noted that the screening methodology made a number of conservative assumptions including:

- All of the slag material used will contain metals at the maximum limits specified in the DECCW blast furnace slag exemption; and
- The maximum annual criteria adopted for all receptors did not allow for differential dispersion of the heavy metals as they moved from the source through the atmosphere over distance to the receptors.

Based on this assessment it is considered unlikely that the use of blast furnace slag as fill in the reclamation area for the Outer Harbour development would result in adverse human health impacts to sensitive receptors surrounding the port. Any potential impacts could be addressed by adopting the air quality mitigation measures for the construction phase of the project as identified in **Section 8.3** of this report.

8.3 Mitigation Measures

Table 37 summarises the main management measures proposed to address emissions of dust and other pollutants from the construction and operational activities. These measures can be evaluated at any time during a project life and reviewed accordingly. It should be noted that the list is not comprehensive and may need to be supplemented with additional site-specific and activity-specific measures. Appropriate mitigation measures should be incorporated into the AQMP.

Table 37: Impact Management Measures

Trigger	Impact	Pollutant	Control Measure	Major Project Construction	Major Project Operation	Concept Plan Operation
Fuel combustion emissions from vehicles and equipment	Increased risk to human health	NO_x CO SO_2 PM_{10} TSP BTEX	Turn engines off whilst parked onsite (including construction equipment when not in use)	X	X	X
			Vehicular access confined to designated access roads	X	X	X
			Equipment, plant and machinery regularly tuned, modified or maintained to minimise visible smoke and emissions	X	X	X
			Site speed limits implemented	X	X	X
			Minimise haul road lengths	X	X	X
Fugitive dust and odour from exposed surfaces and vehicles	Nuisance (dust and odour) Discoloration of buildings or structures Increased risk to human health	PM_{10} TSP Odour	Trucks carrying spoil, sand and/or other loose materials covered to avoid generating wind-blown dust	X	X	X
			Wetting down or use of surfactant on stockpiles (where practicable)	X	X	X
			Wetting down of site surfaces during dry weather including excavation sites, haul roads, and spoil stockpiles and other exposed areas	X		
			Sealing regularly trafficked roads		X	X
			Sealing of operational areas of the Major Project and Concept Plan terminals		X	X
			Stabilising of reclaimed surface areas set aside for future terminal development	X	X	X
			Vehicular access confined to designated access roads	X	X	X
			Prompt clean up of spills	X	X	X
			Complaints management system in place	X	X	X
			Adjusted work practices (as required) based on wind observations and dust monitoring results (detailed in **Section 8.3.1**)	X	X	X

Trigger	Impact	Pollutant	Control Measure	Major Project Construction	Major Project Operation	Concept Plan Operation
Hazardous and other air pollutants (from disturbance of potentially contaminated ground)	Increased risk to human health Nuisance (dust and odour)	NO_x CO SO_2 PM_{10} TSP Odour BTEX	Trucks carrying spoil, soil or other loose materials covered to avoid generating wind-blown dust	X	X	X
			Wetting down of site surfaces during dry weather including excavation sites, haul roads, spoil stockpiles and other exposed areas	X		
			Sealing regularly trafficked roads		X	X
			Sealing of operational areas of the Major Project and Concept Plan terminals		X	X
			Stabilising of reclaimed surface areas set aside for future terminal development	X	X	X

BTEX refers to benzene, toluene, ethylbenzene, and xylenes

8.3.1 Fugitive Dust

The key objectives of any management program are to protect human health and the environment. Best practice management should be employed at all times. From a construction perspective, it is essentially a management exercise. For a long term construction activity, the focus should be on implementing a strict dust management regime supplemented by the use of ambient pollutant monitoring.

The modelling has shown dust (in particular PM_{10}) to be a pollutant of concern from construction and some operational activities. The measurement of dust using one of a variety of monitoring techniques can aid in the quantification and subsequent reduction of off-site dust impacts. The AQMP should address both the construction and operational phases of the development. The AQMP should outline the purpose, methodology and expected outcomes of the dust monitoring program, and should include the following content:

- Dust fraction to be measured i.e. TSP, PM_{10}, $PM_{2.5}$ etc;
- Equipment used to measure selected dust fraction;
- Frequency of the monitoring i.e. sample collection schedule;
- Duration of the monitoring program;
- Location of the monitoring station/s;
- Standards/guidelines that are to be followed for location/construction of the monitoring station, equipment calibration, collection of samples and analysis of samples;
- Calibration methodology and schedule;
- Reporting procedure;
- Regulatory guidelines and compliance criteria; and
- Nominates action levels and contingency measures in the event that air quality approaches or is likely to exceed the relevant compliance criteria.

It is also recommended that consideration be given to the operation of an instantaneous dust monitoring program that could be linked to a reactive dust management plan. The location of an instantaneous dust monitor at the site boundary most affected by dust impacts can alert site personnel when elevated dust levels occur as well as monitoring long term average concentrations. The system should be connected to a meteorological station to compare the measured dust concentrations with measured wind parameters (wind speed and direction). When ambient dust levels are measured above the assessment criteria pre-determined dust reduction measures can be implemented (as outlined in the AQMP). The assessment of the measured dust levels should take into consideration the wind direction to ensure that the port activities are the most likely dust source (i.e. are off-site activities the major cause of the dust reading and hence no action need be taken). The instantaneous dust monitoring program should be included within the AQMP with the information previously listed clearly outlined.

8.3.2 Transport Emissions

The amount of freight transported by rail has been maximised by proportioning the transport modal split to preference rail. Further discussion of this issue is provided in the EA document and Submissions Report.

Whilst direct mitigation measures (primarily relating to particulates) have been identified in **Table 37**, additional measures are available to minimise the emission of other pollutants such as SO_2 and NO_X from transport activities, in particular shipping. The following measures are expected to aid in the reduction of combustion related emissions over time:

- Fuel standards for both land and sea based vehicles have and will continue to improve, which will lead to lower SO_x, NO_x and particulate emissions. In 2008 the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) unanimously adopted amendments to the MARPOL Annex VI regulations to reduce harmful emissions from ships. (see http://www.imo.org/environment/mainframe.asp?topic_id=233 for details). Some of the main changes include:
  - Progressive reductions in SO_x emissions from ships, with the global sulphur cap reduced initially to 3.50% (from the current 4.50%), effective from 1 January 2012; then progressively to 0.50 %, effective from 1 January 2020.
  - Progressive reductions in NO_x emissions from marine engines.
- A Fuel Standards Consultative Committee was established under the Fuel Quality Standards Act 2000 as a formal consultation mechanism to promote uniformity in Australian fuel standards, to facilitate investment in new fuels and technology, and to be a champion for new fuel standards. From an historical perspective, fuel standards have been modified a number of times since the Fuel Quality Standards Act 2000 came into force in 2002 with the introduction of uniform fuel standards. An example of action taken on fuel standards since their inception in 2002 can be noted in the committee's action in reducing the national standard for sulphur content in diesel. The allowable content in 2002 was set at a maximum of 500ppm, which was reduced to 50ppm in 2006 and further reduced to 10ppm in 2009. There has been no further action proposed as of the date of this report for fuel standards but given the historical trends toward further tightening of standards further improvements in fuel quality could be expected (although the scope and nature of these changes cannot be predicted at this stage).
- Dredging ship pollution exhaust systems often include a catalytic convertor system to mitigate exhaust pollutions, with efficiency generally greater than 85%. This efficiency level will increase over time through research and as better technology becomes available. This is also true of all pollution abatement systems, such as those on cars and trains.
- Berth design would include allowance for alternative marine power (AMP) for vessels (also known as cold-ironing) while at berth. The success of AMP would depend upon suitable international standards being adopted for the supply of shore-based electricity to ships and a "critical mass" of vessels to be equipped so as to receive shore power. The adoption of alternative marine power would effectively remove emissions from ship boilers whilst in berth, eliminating a significant source of NO_X and particulate emissions.
- Possible adoption of programs such as the "Green Award" to offer incentives for less polluting vessels to call at Port Kembla. A Green Award ship meets high but manageable technical and managerial requirements and confirms the high quality of the vessel. Crude oil tankers, product tankers and bulk carriers with a minimum deadweight of 20,000 ton may apply for inspection and certification.

9.0 Conclusion

The assessment of the PKOHD has identified potential exceedences of ambient air quality goals. Exceedences are expected to relate to short term localised particulate (PM_{10}) from construction and operational activities and isolated NO_2 impacts from construction activities only.

There are no specific characteristics shown from the meteorological data analyses that would be expected to adversely affect air pollution in the area immediately surrounding the PKOHD. On-site meteorological analysis may be required to aid in the assessment of pollutant impacts related to meteorological conditions, and may benefit future assessments of activities to be added to the PKOHD.

There are no significant regional exceedences of relevant air quality guidelines with the exception of 24 hour average PM_{10}. These dust levels are contributed to by natural processes such as bush fires as well as anthropogenic influences such as motor vehicles. The dust gauge results also show there are currently elevated deposited dust levels in the local area.

The dredge spoil managed during the Major Project (Stage 1) was highlighted as a potential source of odour from the site. Dredging operations have been designed so that the spoil is not planned to be handled or stockpiled above the water surface and hence dredge spoil is therefore not expected to be a source of odour from the site.

The modelling results for the Major Project (Stage 1) construction suggest that the short term NO_2, and PM_{10} GLCs may exceed the DECCW criteria at discrete receptors close to the development boundary. NO_2 concentrations were predicted to exceed the DECCW criteria for one hour of the modelling period at one receptor only and are not expected to exceed the NEPM assessment criteria. NO_2 impacts are therefore considered acceptable for the construction period of the project. Dust impacts of the construction phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP and CEMP.

The modelling results for the Major Project (Stage 1) operation suggest that only short term PM_{10} GLCs are likely to exceed the DECCW criteria at some discrete receptors. Dust impacts of the operation phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP and OEMP.

The modelling results for the Concept Plan operation suggest that the short term PM_{10} GLCs may exceed the DECCW criteria at some discrete receptors. Dust impacts of the operation phase can be limited by implementing site specific ‘best practice’ dust mitigation measures which should be incorporated into the site’s AQMP and OEMP.

It is expected that construction activities during the Major Project construction represent the worst case impacts due to the majority of the earthworks being undertaken during this period. As such, Concept Plan construction activities were not modelled in the AQIA. Future project applications will be required for the Concept plan and future construction impacts may be required to be assessed during these stages.

Quantitative assessment of the Port Kembla Outer Harbour development suggests that due to the conservativeness of the dispersion modelling, and providing that appropriate mitigation measures and an AQMP are undertaken, the development should not result in significant adverse impacts on local or regional air quality.

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Figures

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AECOM

PORT KEMBLA PORT CORPORATION

PORT KEMBLA OUTER HARBOUR DEVELOPMENT REGIONAL VIEW

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AECOM

PORT KEMBLA PORT CORPORATION

PORT KEMBLA OUTER HARBOUR DEVELOPMENT LOCAL VIEW

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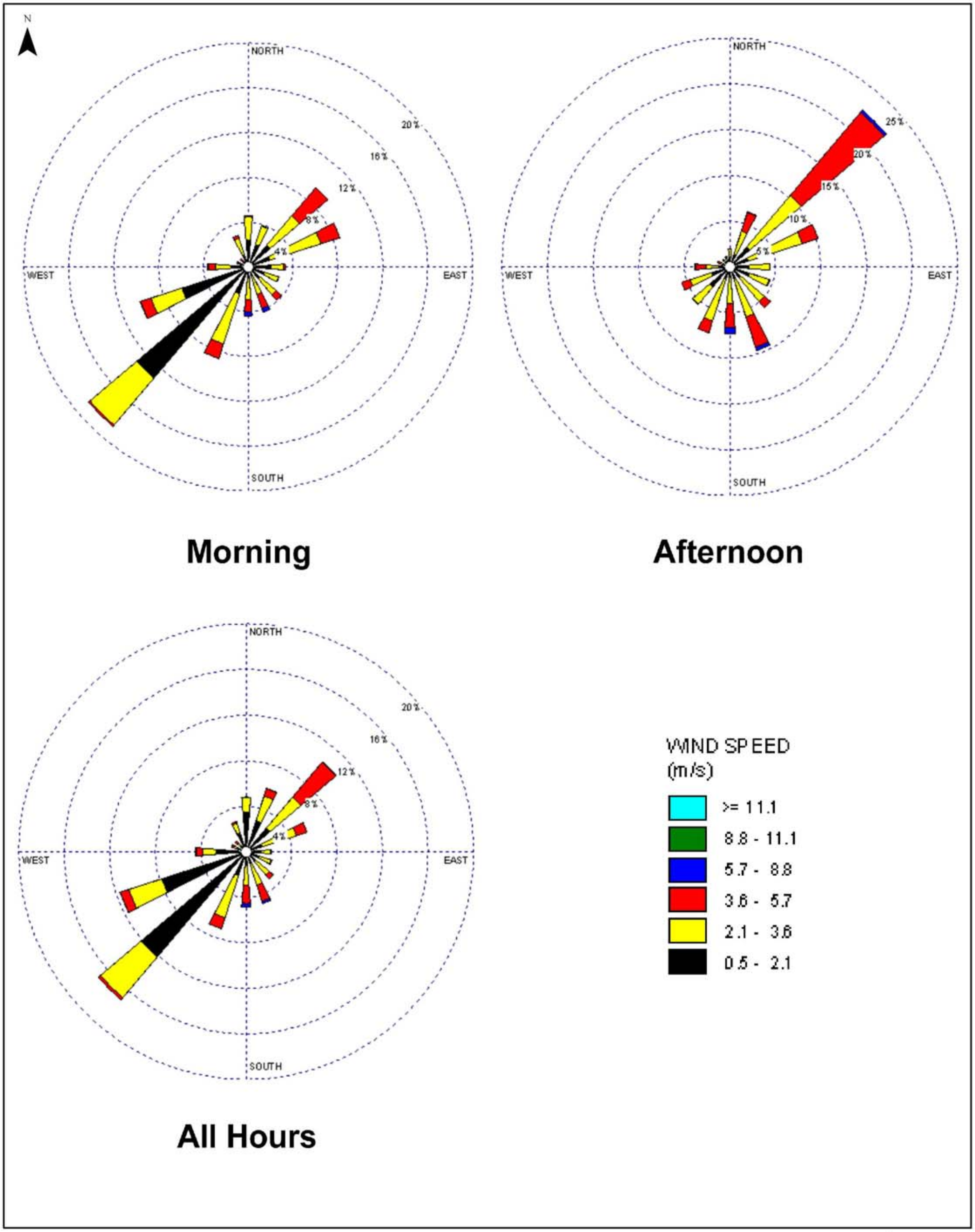

PORT KEMBLA PORT CORPORATION

WOLLONGONG WIND ROSES - ALL HOURS JULY 2006 - JUNE 2007

AUG 2010

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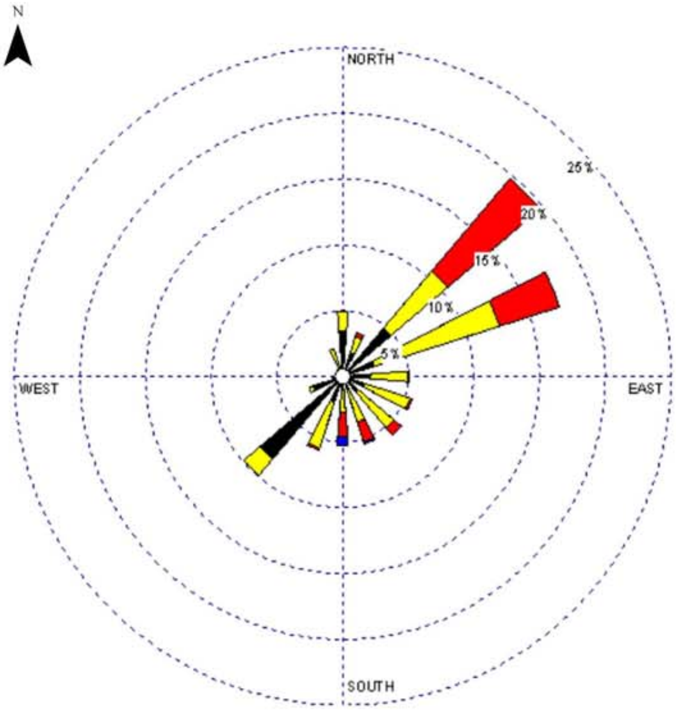

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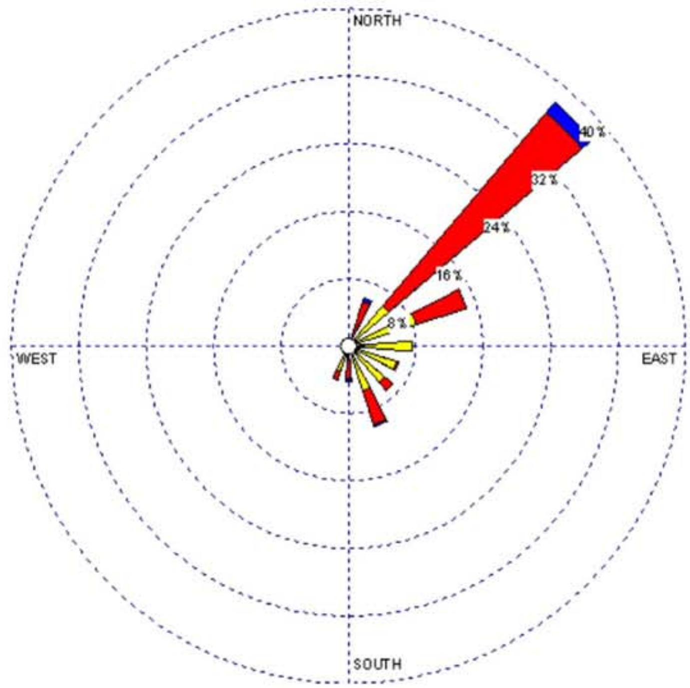

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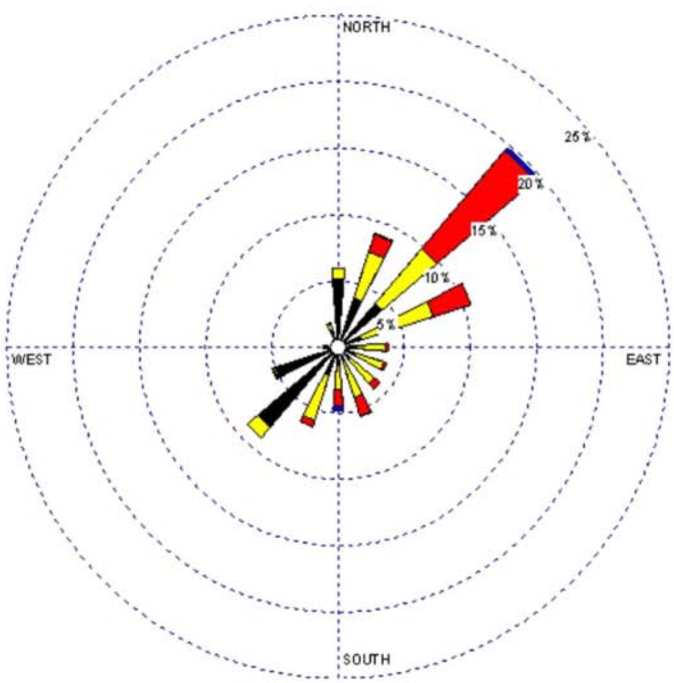

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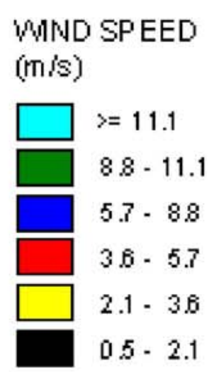

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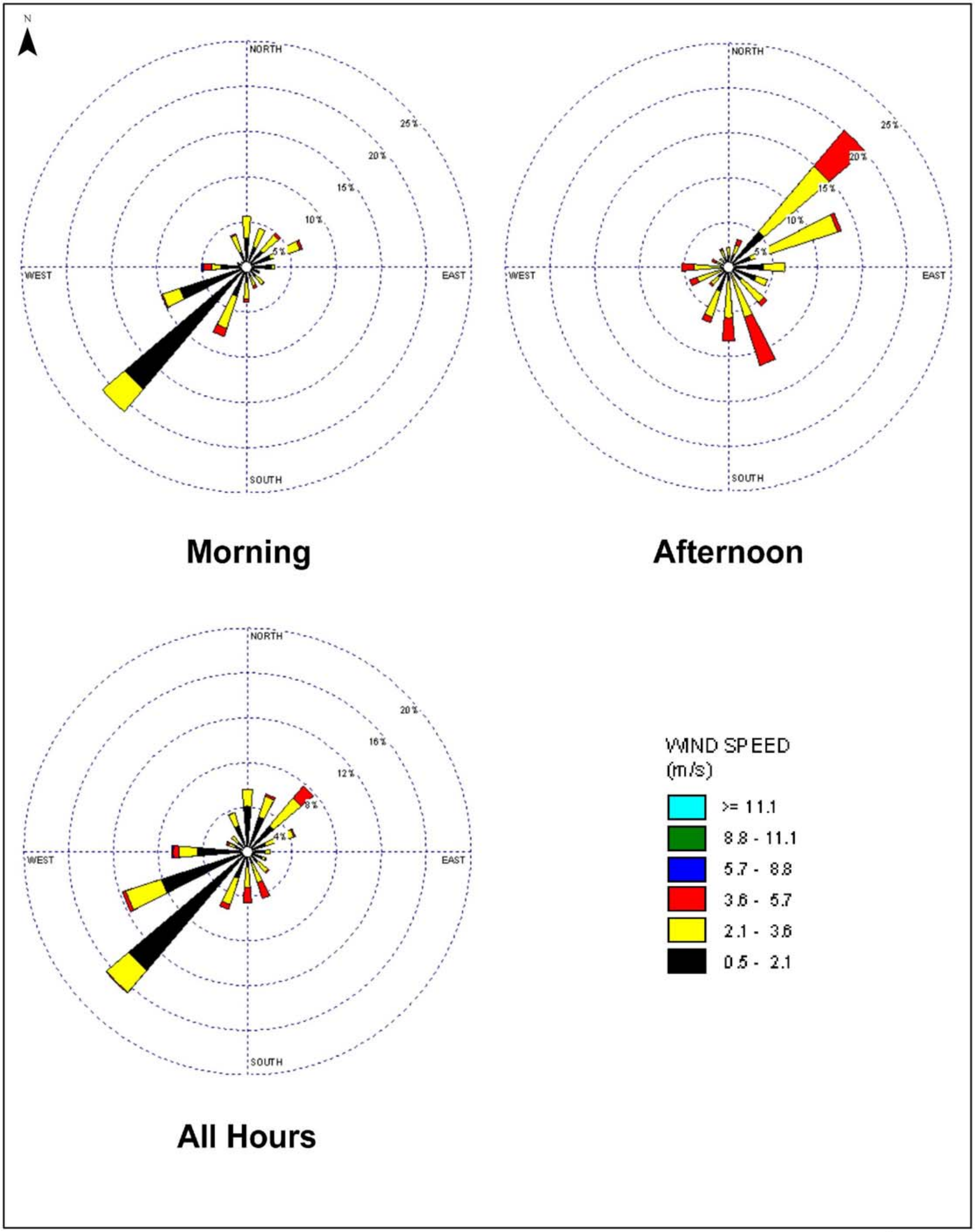
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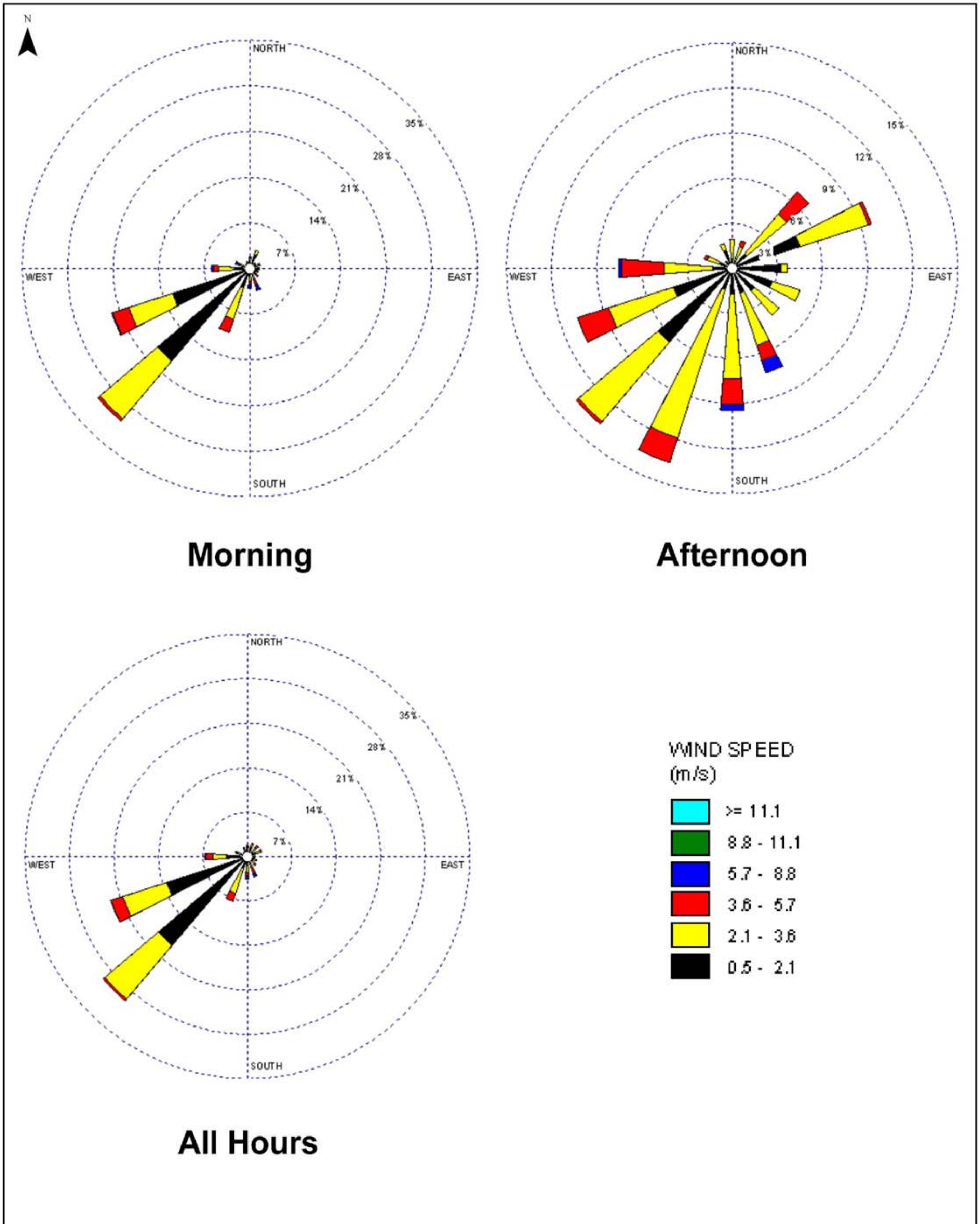
25%
Afternoon
NORTH
WEST
EAST
SOUTH
4%
8%
12%
16%
20%
All Hours
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1

AECOM



PORT KEMBLA PORT CORPORATION

WOLLONGONG WIND ROSES - WINTER JULY 2006 - JUNE 2007

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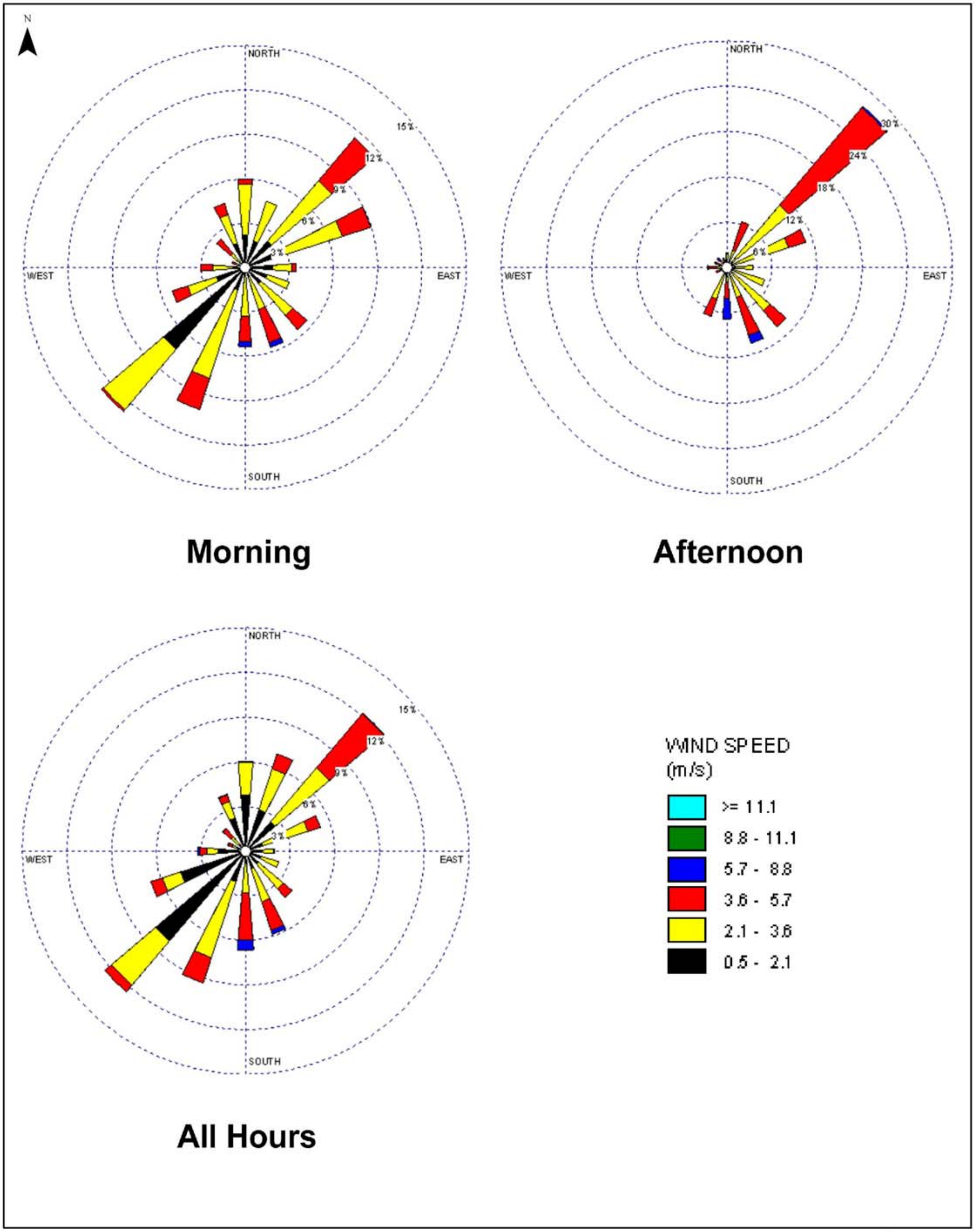
AECOM



PORT KEMBLA PORT CORPORATION

WOLLONGONG WIND ROSES - SPRING JULY 2006 - JUNE 2007

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Source
Sensitive receptor
Criteria (ug/m^3)
Rail infrastructure upgrade
Development footprint
Dredging area

SCENARIO 1A - MAJOR PROJECT: CONSTRUCTION

PREDICTED PM_{10} 24 HOUR AVERAGE GLC IN ISOLATION FROM BACKGROUND

Source: Google (2009), DigitalGlobe (2009)

0 125 250 500 m

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Source
Sensitive receptor
Criteria (ug/m³)
Rail infrastructure upgrade
Development footprint
Dredging area

SCENARIO 1B - MAJOR PROJECT: OPERATION

PREDICTED PM_{10} 24 HOUR AVERAGE GLC IN ISOLATION FROM BACKGROUND

Source: Google (2009), DigitalGlobe (2009)

0 125 250 500 m

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SCENARIO 2 - CONCEPT PLAN: OPERATION

PREDICTED PM_{10} 24 HOUR AVERAGE GLC IN ISOLATION FROM BACKGROUND

Source: Google (2009), DigitalGlobe (2009)

0 125 250 500 m

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Appendix A

Revised Emissions Inventory

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Major Project Construction Emissions Inventory

MAJOR PROJECT CONSTRUCTION
PKOHD TRAIN EMISSIONS INVENTORY

Trains to Construction Stockpile

NPI	Emission factor	Emissions from HGV	Total	Total
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	6700	0.60	0.20
CO	25.82	3899	0.35	0.12
PM10	3.53	533	0.047	0.016
SO2	0.0167	3	0.00022	0.00007

Fuel Type =	Diesel	
Idle consumption =	24	L/h/loco
Throttle 5 consumption (loaded) =	290	L/h/loco
Throttle 3 consumption (empty) =	146	L/h/loco
Idling time =	1	h
Loaded train forming up =	0.5	h
Empty train breaking =	0.5	h
Idling time fuel cons. =	24	L
Loaded train forming up fuel cons.=	145	L
Empty train breaking fuel cons.=	73	L
Total fuel cons. per loco =	242	L/loco
Trains per day =	1	
Locos per train =	2	
Locos per day =	2	
Number of volume sources =	3	(For modelling purposes only)
Litres per year =	151008	L/y
	151	KL/y
Litres per day =	484	L/day

MAJOR PROJECT CONSTRUCTION
PKOHD TRUCK EMISSIONS INVENTORY

Combustion Engines

Type of Vehicles =	HGV (Heavy goods vehicles)	
Fuel Type =	Diesel	
Number of trucks =	71760	/year
On-site road distance (2way) =	1.1	km
Number of volume sources =	6	(modelling purposes only)
Distance travelled in year =	78936	km/y

Met AQS	Emission factor	Emissions from HGV	Total	Total
Substance	**g/km**	**g/year**	**g/s**	**g/s/source**
Nox	15.72	1240874	0.1	0.02
CO	8.01	632277	0.06	0.009
PM10	0.105	8288	0.0007	0.0001
SO2	0.048	3789	0.0003	0.0001

MAJOR PROJECT CONSTRUCTION
PKOHD SHIP EMISSIONS INVENTORY

Dredging Equipment

Note:

1lb =	0.45	kg
1kw =	1.36	hp

Cutter Suction Dredger

Power = 1705 kW gained from http://www.boskalis.com
1254 hp

AP42	Emission factor	Emissions from Engines		
Substance	lb/hp-hr	**lb/hr**	**kg/hr**	**g/s**
Nox	0.024	30.1	13.65	3.79
CO	0.00055	0.7	0.31	0.09
PM10	0.0007	0.9	0.40	0.11
SO2	0.000809	1.0	0.46	0.13

Backhoe Dredger

Power = 1010 kW gained from http://www.boskalis.com
743 hp

AP42	Emission factor	Emissions from Engines		
Substance	lb/hp-hr	**lb/hr**	**kg/hr**	**g/s**
Nox	0.024	17.8	8.08	2.25
CO	0.00055	0.4	0.19	0.05
PM10	0.0007	0.5	0.24	0.07
SO2	0.000809	0.6	0.27	0.08

Total

	g/s
Nox	6.04
CO	0.14
PM10	0.18
SO2	0.20

MAJOR PROJECT CONSTRUCTION
PKOHD STOCKPILE EMISSIONS INVENTORY

CONSTRUCTION STOCKPILE

Summary

Location	*Hrs of Operation*	*TSP ER*	*PM10 ER*	*Source Type*	ER type
		24 hrs	24 hrs		
Construction SP - All SP	24 hrs	0.0000056	0.0000028		
Construction SP - Active SP	Variable	0.00088	0.00036	Area	g/s/m2

Mass Fraction

Source	TSP	PM10
Construction SP - All SP	0.50	0.5
Construction SP - Active SP	0.58	0.42

All Stockpile				
Wind Erosion				
Area	15000	m2	50% of stockpile area	
	1.50	ha		
Reduction from water sprays	50	%		
EF	0.40	kg/ha/hr	TSP	
	0.20	kg/ha/hr	PM10	
ER	0.60	kg/hr	TSP	
	0.30	kg/hr	PM10	
	0.17	g/s	TSP	
	0.08	g/s	PM10	
Assuming reduction from water sprays	0.08	g/s	TSP	
	0.04	g/s	PM10	
Active area of Stockpile				
Area	1500	m2		10% of all stockpile
Days active per year	312	days		
Hours active per weekday	11	hours	mon-fri, 7am to 6pm	
Hours active per Saturday	5	hours	sat, 8am - 1pm	
Total hours possible	3120	hours		
Trucks dumping material on stockpile				
Mass of material moved	703477	t/yr	(3410799m3 * 1.65 / 8)	
	225	t/hour		
Reduction from water sprays	50	%		
EF	0.01	kg/t	TSP	Default Factors from
	0.004	kg/t	PM10	NPI Manual Table 1
ER	2.71	kg/hr	TSP	
	0.97	kg/hr	PM10	
	0.75	g/s	TSP	
	0.27	g/s	PM10	
Assume water sprays (50% reduction, NPI Table 3)	0.38	**g/s**	**TSP**	
	0.13	**g/s**	**PM10**	
Unloading from stockpiles				
Mass of material moved	703477	t/yr		
	225	t/hour		
Reduction from water sprays	50	%		
EF	0.03	kg/t	TSP	Default Factors from
	0.01	kg/t	PM10	NPI Manual Table 1
ER	6.76	kg/hr	TSP	
	2.93	kg/hr	PM10	
	1.88	g/s	TSP	
	0.81	g/s	PM10	
Assume water sprays (50% reduction, NPI Table 3)	0.94	**g/s**	**TSP**	
	0.41	**g/s**	**PM10**	
Total	**1.32**	**g/s**	**TSP**	
	0.54	**g/s**	**PM10**	
END				

Major Project Operation Emissions Inventory

MAJOR PROJECT OPERATIONS
PKOHD TRAIN EMISSIONS INVENTORY

PKOHD Trains

Throttle Levels

Multi-Purpose Berth – 4 trains per day (bulk freight and assuming dumper)			
Train Movement	**Throttle Level & Time** **Peak Operations**	**No. of Locos**	**ID # (used later in EI)**
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	2	1
Train idles in holding siding then enters loop and unloads adjacent to multi-purpose berth	Idle – 2 hours	1	2
Train leaves via Balloon Loop and North Yard	Throttle 5 – 15 minutes	2	3

Trains in South Yard TR1-3

Diesel Powered Locomotives

Number of sources (vol) = 3

Per Loco data from Train Section
Idle consumption = 24 L/h
Throttle 5 consumption (in) = 290 L/h

Train Movements - South Yard					
ID #	**Trains/day**	**Throttle Level**	**Time (min)**	**Locos**	**Total Fuel L/Day**
1	4	5	15	2	580
				Total	**580**

Litres per day = 580 L/day
Litres per year = 211700 L/y
Diesel used in year = 212 KL/y

	Emission factor	**Emissions from HGV**	**Total**	**Total**
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	9393	0.30	0.099
CO	25.82	5466	0.17	0.058
PM10	3.53	747	0.024	0.0079
SO2	0.0167	3.5	0.00011	0.000037

Trains in Multi-purpose Berth Unloading Siding TR4-6

Diesel Powered Locomotives

Number of sources (vol) = 3

Per Loco data from Train Section
Idle consumption = 24 L/h
Throttle 5 consumption (loaded) = 290 L/h
Throttle 3 consumption (empty) = 146 L/h

Train Movements - Multi-purpose berth Unloading					
ID #	Trains/day	Throttle Level	Time (min)	Locos	Total Fuel L/Day
2	4	Idle	120	1	192
3	4	5	15	2	580
				Total	**772**

Litres per day =	772	L/day
Litres per year =	281780	L/y
Diesel used in year =	282	KL/y

	Emission factor	Emissions from HGV	Total	Total
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	12502.6	0.40	0.13
CO	25.82	7275.6	0.23	0.077
PM10	3.53	994.7	0.032	0.011
SO2	0.0167	4.7	0.00015	0.000050

MAJOR PROJECT OPERATIONS
PKOHD TRUCK EMISSIONS INVENTORY

Combustion Engines

Type of Vehicles =	HGV (Heavy goods vehicles)	
Fuel Type =	Diesel	
Number of trucks =	60714	/year
	166	/day
	7	/hour
On-site road distance (2way) =	1.1	km
Number of volume sources =	6	(modelling purposes only)
Distance travelled in year =	66785.4	km/y
	183	km/d
	8	km/hr

Met AQS	Emission factor	Emissions from HGV	Total	Total
Substance	**g/km**	**g/year**	**g/s**	**g/s/source**
Nox	15.72	1049866.488	0.03	0.006
CO	8.01	534951	0.02	0.003
PM10	0.105	7012	0.000	0.00004
SO2	0.048	3206	0.0001	0.00002

MAJOR PROJECT OPERATIONS
PKOHD SHIP EMISSIONS INVENTORY

Bulk Material Berth

Number of berths	1		
Time at Berth =	14	hrs/day	

Auxiliary power engines

Auxiliary Power =	600	kW	Default value from NPI
Fuel type =	Weighted average fuel burn from NPI		Used as fuel type is unknown

NPI	Emission factor	Emissions from Engines	Total
Substance	kg/kwh	kg/day/berth	g/s/berth
Nox	0.0145	123.9	1.43
CO	0.0011	9.4	0.11
PM10	0.001	8.5	0.10
SO2	0.0097	82.9	0.96

Auxiliary boilers

Estimated fuel consumption =	0.0125	t/hr	Default value from NPI
Fuel Type =	Residual oil		Only option in NPI

NPI	Emission factor	Emissions from Boilers	Total
Substance	kg/tonne	kg/day/berth	g/s/berth
Nox	12.3	2.2	0.025
CO	4.6	0.8	0.009
PM10	1.3	0.2	0.003
SO2	54	9.6	0.111

TOTAL	Total
Substance	g/s/ship
Nox	1.460
CO	0.118
PM10	0.102
SO2	1.071

MAJOR PROJECT OPERATIONS

PKOHD STOCKPILE EMISSIONS INVENTORY

BULK MATERIAL STOCKPILE

Summary

Location	*Hrs of Operation*	*TSP ER*	*PM10 ER*	*Source Type*	ER type
		24 hrs	24 hrs		
Bulk Material SP - All SP	24 hrs	0.0000056	0.0000028	Area	g/s/m2
Bulk Material SP - Active SP	24 hrs	0.0012	0.00051	Area	g/s/m2

Mass Fraction

Source	TSP	PM10
Bulk Material SP - All SP	0.50	0.50
Bulk Material SP - Active SP	0.57	0.43

All Stockpile

Wind Erosion

Area	11250	m2		
	1.13	ha		
Emission factor (EF)	0.40	kg/ha/hr	TSP	Default Factors from
	0.20	kg/ha/hr	PM10	NPI Manual Table 1
ER	0.45	kg/hr	TSP	
	0.23	kg/hr	PM10	
	0.13	g/s	TSP	
	0.06	g/s	PM10	
Assuming reduction from water sprays (50%, NPI Table 3)	0.06	g/s	TSP	
	0.03	g/s	PM10	

Active area of Stockpile					
Area	1125		m2		10% of all stcokpile
Loading Stockpiles					
Days active per year	365		days		
Hours active per day	24		hours		
Mass of material moved	2450000		t/yr		
	6712	t/day			
	280	t/hour			
EF	0.004		kg/t	TSP	Default Factors from
	0.002	kg/t		PM10	NPI Manual Table 1
ER	1.12		kg/hr	TSP	
	0.48	kg/hr		PM10	
	0.31	g/s		TSP	
	0.13	g/s		PM10	
Assume water sprays (50% reduction, NPI Table 3)	0.16		g/s	TSP	
	0.07	g/s		PM10	
Unloading Stockpiles					
Days active per year	365		days		
Hours active per day	24		hours		
Mass of material moved	2450000		t/yr		
	6712	t/day			
	280	t/hour			
EF	0.03		kg/t	TSP	Default Factors from
	0.01	kg/t		PM10	NPI Manual Table 1
ER	8.39		kg/hr	TSP	
	3.64	kg/hr		PM10	
	2.33	g/s		TSP	
	1.01	g/s		PM10	
Assume water sprays (50% reduction, NPI Table 3)	1.17		g/s	TSP	
	0.50	g/s		PM10	
Total	**1.32**		**g/s**	**TSP**	
	0.57	**g/s**		**PM10**	
END					

Concept Plan Operation Emissions Inventory

CONCEPT PLAN OPERATIONS
SHIP EMISSIONS INVENTORY

PKOHD Ships			
Bulk Material Berth			**VS1**
Number of berths	1		
Time at Berth =	14	hrs/day	
Auxiliary power engines			
Auxiliary Power =	600	kW	Default value from NPI
Fuel type =	Weighted average fuel burn from NPI		Used as fuel type is unknown

	Emission factor	Emissions from Engines	Total
Substance	**kg/kwh**	**kg/day/berth**	**g/s/berth**
Nox	0.0145	121.8	1.41
CO	0.0011	9.2	0.11
PM10	0.001	8.4	0.10
SO2	0.0097	81.5	0.94

Auxiliary boilers			
Estimated fuel consumption =	0.0125	t/hr	Default value from NPI
Fuel Type =	Residual oil		Only option in NPI

	Emission factor	Emissions from Boilers	Total
Substance	**kg/tonne**	**kg/day/berth**	**g/s/berth**
Nox	12.3	2.2	0.025
CO	4.6	0.8	0.009
PM10	1.3	0.2	0.003
SO2	54	9.5	0.109

TOTAL	Total	Mass Emission Rate
Substance	**g/s/berth**	**g/s**
Nox	1.435	1.43
CO	0.116	0.12
PM10	0.100	0.10
SO2	1.05	1.05

Bulk Cargo Berth			**VS2-3**
Number of berths	2		
Time at Berth =	7	hrs/day/berth	
Auxiliary power engines			
Auxiliary Power =	600	kW	Default value from NPI
Fuel type =	Weighted average fuel burn from NPI		Used as fuel type is unknown

	Emission factor	Emissions from Engines	Total
Substance	**kg/kwh**	**kg/day/berth**	**g/s/berth**
Nox	0.0145	60.9	0.70
CO	0.0011	4.6	0.05
PM10	0.001	4.2	0.05
SO2	0.0097	40.7	0.47

Auxiliary boilers

Estimated fuel consumption =	0.0125	t/hr	Default value from NPI
Fuel Type =	Residual oil		Only option in NPI

	Emission factor	Emissions from Boilers	Total
Substance	**kg/tonne**	**kg/day/berth**	**g/s/berth**
Nox	12.3	1.1	0.012
CO	4.6	0.4	0.005
PM10	1.3	0.1	0.001
SO2	54	4.7	0.055

TOTAL	**Total**	**Mass Emission Rate**
Substance	**g/s/berth**	**g/s**
Nox	0.717	1.43
CO	0.058	0.12
PM10	0.050	0.10
SO2	0.526	1.05

Container Berth			**VS4-7**
Number of berths	4		
Time at Berth =	10	hrs/day/berth	

Auxiliary power engines

Auxiliary Power =	600	kW	Default value from NPI
Fuel type =	Weighted average fuel burn from NPI		Used as fuel type is unknown

	Emission factor	Emissions from Engines	Total
Substance	**kg/kwh**	**kg/day/berth**	**g/s/berth**
Nox	0.0145	87.0	1.01
CO	0.0011	6.6	0.08
PM10	0.001	6.0	0.07
SO2	0.0097	58.2	0.67

Auxiliary boilers

Estimated fuel consumption =	0.0125	t/hr	Default value from NPI
Fuel Type =	Residual oil		Only option in NPI

	Emission factor	Emissions from Boilers	Total
Substance	**kg/tonne**	**kg/day/berth**	**g/s/berth**
Nox	12.3	1.5	0.018
CO	4.6	0.6	0.007
PM10	1.3	0.2	0.002
SO2	54	6.8	0.078

TOTAL	**Total**	**Mass Emission Rate**
Substance	**g/s/berth**	**g/s**
Nox	1.025	4.10
CO	0.083	0.33
PM10	0.071	0.29
SO2	0.752	3.01

END

CONCEPT PLAN OPERATIONS
TRAIN EMISSIONS INVENTORY

PKOHD Trains

Train Movement Identification

Multi-Purpose Berth – 4 trains per day (bulk freight and assuming dumper)			
Train Movement	**Throttle Level & Time**	**No. of Locos**	**ID # (used later in EI)**
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	2	1
Train idles in holding siding then enters loop and unloads adjacent to multi-purpose berth	Idle – 2 hours	1	2
Train leaves via Balloon Loop and North Yard	Throttle 5 – 15 minutes	2	3

Multi-Purpose Berth – 1 train per day (general freight)			
Train Movement	**Throttle Level & Time**	**No. of Locos**	**ID #**
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	2	4
Train idles in holding siding in South Yard while shunting occurs	Idle – 2 hours	1	5
Train moves to unloading siding adjacent to multi-purpose berth	Throttle 5 – 15 minutes	1	6
Train idles in unloading siding adjacent to multi-purpose berth while unloading, then shunt & reform in holding siding in South Yard	Idle - 1 hours	1	7a
	Idle - 1 hours	1	7b
Train leaves holding siding and exit via Balloon Loop and North Yard	Throttle 5 – 15 minutes	2	8

Container Berths – 16 trains per day			
Train Movement	**Throttle Level & Time**	**No. of Locos**	**ID #**
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	2	9
Train idles in holding siding in South Yard while splitting	Idle – 1 hour	2	10
Train moves to container berth sidings	Throttle 5 – 15 minutes	2	11
Train idles in container berth sidings and returns to holding siding in South Yard to reform before exiting	Idle – 0.5 hour	2	12a
	Idle – 0.5 hour	2	12b
Train leaves from exit siding in South Yard	Throttle 5 – 15 minutes	2	13

Trains in South Yard		**TR1-3**			

Diesel Powered Locomotives

Number of sources (vol) = 3

Per Loco data from Train Section

Idle consumption =	24	L/h
Throttle 5 consumption (in) =	290	L/h

Train Movements - South Yard					
ID #	**Trains/day**	**Throttle Level**	**Time (min)**	**Locos**	**Total Fuel L/Day**
1	4	5	15	2	580
4	1	5	15	2	145
5	1	Idle	120	1	48
7a	1	Idle	60	1	24
8	1	5	15	2	145
9	16	5	15	2	2320
10	16	Idle	60	2	768
12b	16	Idle	30	2	384
13	16	5	15	2	2320
				Total	**6734**

Litres per day =	6734	L/day
Litres per year =	2457910	L/y
Diesel used in year =	2458	KL/y

	Emission factor	**Emissions from HGV**	**Total**	**Total**
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	109057.5	3.5	1.15
CO	25.82	63463.2	2.0	0.67
PM10	3.53	8676.4	0.28	0.092
SO2	0.0167	41.0	0.0013	0.00043

Trains in Multi-purpose Berth Unloading Siding TR4-6

Diesel Powered Locomotives

Number of sources (vol) = 3

Per Loco data from Train Section

Idle consumption =	24	L/h
Throttle 5 consumption (loaded) =	290	L/h
Throttle 3 consumption (empty) =	146	L/h

Train Movements - Multi-purpose berth Unloading					
ID #	**Trains/day**	**Throttle Level**	**Time (min)**	**Locos**	**Total Fuel L/Day**
2	4	Idle	120	1	192
3	4	5	15	2	580
6	1	5	15	1	73
7b	1	Idle	60	1	24
				Total	**869**

Litres per day = 869 L/day

Litres per year =	317003	L/y
Diesel used in year =	317	KL/y

	Emission factor	Emissions from HGV	Total	Total
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	14065.4	0.45	0.15
CO	25.82	8185.0	0.26	0.087
PM10	3.53	1119.0	0.035	0.012
SO2	0.0167	5.3	0.00017	0.000056

Trains in Container Terminal | **VS8-15**

Diesel Powered Locomotives

Number of sources (vol) =	8	
Per Loco data from Train Section		
Idle consumption =	24	L/h
Throttle 5 consumption (in) =	290	L/h
Throttle 3 consumption (out) =	146	L/h

Train Movements - Continer berth

ID #	Trains/day	Throttle Level	Time (min)	Locos	Total Fuel L/Day
11	16	5	15	2	2320
12a	16	Idle	30	2	384
				Total	**2704**

Litres per day =	2704	L/day
Litres per year =	986960	L/y
Diesel used in year =	987	KL/y

	Emission factor	Emissions from HGV	Total	Total
Substance	**kg/kL**	**kg/year**	**g/s**	**g/s/source**
Nox	44.37	43791.4	1.39	0.17
CO	25.82	25483.3	0.8	0.10
PM10	3.53	3484.0	0.11	0.014
SO2	0.0167	16.5	0.00052	0.000065

END

CONCEPT PLAN OPERATIONS
TRUCK EMISSIONS INVENTORY

PKOHD Trucks		VS 16-25		
Type of Vehicles =	HGV (Heavy goods vehicles)			
Fuel Type =	Diesel			
Number of trucks =	184714	/year		
	506	/day		
On-site road distance (2way) =	1.6	km	800m one way	
Number of sources (vol) =	10			
Distance travelled in year =	295542.4	km/y		
	810	km/d		
Met AQS	**Emission factor**	**Emissions from HGV**	**Total**	**Total**
Substance	**g/km**	**g/year**	**g/s**	**g/s/source**
Nox	15.72	4645927	0.15	0.015
CO	8.01	2367295	0.08	0.008
PM10	0.105	31032	0.001	0.000
SO2	0.048	14186	0.0004	0.000
END				

CONCEPT PLAN OPERATIONS
STOCKPILE EMISSIONS INVENTORY

PKOHD Bulk Material Stockpile

Summary

		Emission Rate					
		g/s/m2		g/s			
Location	*Hrs of Operation*	*TSP ER*	*PM10 ER*	*TSP ER*	*PM10 ER*	*Source Type*	
Bulk Material SP - All SP	24 hrs	0.000006	0.000003	0.13	0.063	Area	OPSTK
Bulk Material SP - Active SP	24 hrs	0.00059	0.00025	1.32	0.57	Area	ACTSTK

Mass Fraction

Source	TSP	PM10
Bulk Material SP - All SP	0.50	0.50
Bulk Material SP - Active SP	0.57	0.43

All Stockpile	OPSTK	
Wind Erosion		
Area	22500	m2	50% of stockpile area
Reduction from water sprays	50	%	
	2.25	ha	
EF	0.40	kg/ha/hr	TSP
	0.20	kg/ha/hr	PM10
ER	0.90	kg/hr	TSP
	0.45	kg/hr	PM10
	0.25	g/s	TSP
	0.13	g/s	PM10
Assuming reduction from water sprays	0.13	g/s	TSP
	0.06	g/s	PM10

Active area of Stockpile		ACTSTK					
Area	2250	m2		10% of all stockpile			
Loading Stockpiles							
Days active per year	365	days					
Hours active per day	24	hours					
Mass of material moved	2450000	t/yr					
	6712.33	t/day					
	279.68	t/hour					
Reduction from water sprays	50	%					
EF	0.004	kg/t	TSP	Default Factors from			
	0.002	kg/t	PM10	NPI Manual Table 1			
ER	1.12	kg/hr	TSP				
	0.48	kg/hr	PM10				
	0.31	g/s	TSP				
	0.13	g/s	PM10				
Assume water sprays (50% reduction, NPI Table 3)	0.16	**g/s**	**TSP**				
	0.07	**g/s**	**PM10**				
Unloading Stockpiles							
Days active per year	365	days					
Hours active per day	24	hours					
Mass of material moved	2450000	t/yr					
	6712.33	t/day					
	279.68	t/hour					
Reduction from water sprays	50	%					
EF	0.03	kg/t	TSP	Default Factors from			
	0.01	kg/t	PM10	NPI Manual Table 1			
ER	8.39	kg/hr	TSP				
	3.64	kg/hr	PM10				
	2.33	g/s	TSP				
	1.01	g/s	PM10				
Assume water sprays (50% reduction, NPI Table 3)	1.17	**g/s**	**TSP**				
	0.50	**g/s**	**PM10**				
Total	**1.32**	**g/s**	**TSP**				
	0.57	**g/s**	**PM10**				
END							

Appendix B

Comparison of Original and Revised Emissions Inventories and Mass Emission Rates

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Revision of Emissions Inventory

Modifications have been made to the emissions inventory provided in the previous version of this document dated 11 February 2010 which was placed on public exhibition. These modifications were undertaken to refine the input information to better reflect operational characteristics and correct some inconsistencies noted by DECCW in the original emissions inventory. A comparison of the original and revised emission inventory, together with the mass emission rates is provided below.

Data Input	Original Assumption	Revised Assumption	Reason	Scenario where change is applicable		
				Major Project Construction	Major Project Operation	Concept Plan Operation
Throughput volume applied to stockpiles	4.25 mtpa	2.45 mtpa	PKOHD advised AECOM that 0.8mtpa is existing trade that is not stockpiled (bulk liquid, stored in sheds etc) and that 1mtpa is cement clinker that is fully enclosed.		X	X
Density of fill material provided as m^3	No density value was applied to the fill material	A density of 1.65 t/m^3 was applied to fill material	A density value of 1.65 t/m^3 was applied to fill material volume that was provided in m^3. This increased the total fill tonnage.	X		
Construction fill time frame	3.4million m^3 applied to each of the 8 years of construction period	3.4million m^3 averaged over 8 years; 426,350 m^3/yr or 703,477 t/year	The original emissions inventory applied the total construction fill to each year of the project instead of averaging over the entire construction phase.	X		
Number of trains applied in the Major Project Construction	3 trains per day	1 train per day	The original emissions inventory was revised to represent the expected trains during major project construction	X		
Number of trains applied in the Major Project Operation	2 trains per day	4 trains per day	The original emissions inventory was revised to represent the expected trains during major project operation		X	
Modelling of South Yard trains as emissions sources	South Yard trains modelled as volume sources	South Yard trains modelled as stack sources	As detailed in **Section 6.2**, modelling trains that are predominantly stationary or move very slowly as stack sources is expected to predict more realistic impacts.		X	X
Revision of Concept Plan train throttle levels and times	Coarse data used	Refined data used	More refined information has been gained in regards to train movements (refer to **Section 6.2)** based on discussions with PKPC's consultant who has recently been engaged to undertake the Rail Masterplan. The movements are conservative estimations of peak operating capacity.		X	X

Data Input	Original Assumption	Revised Assumption	Reason	Scenario where change is applicable		
				Major Project Construction	Major Project Operation	Concept Plan Operation
Application of ship emission rate to each berth in the Concept Plan	Summed the emissions from all berth types, and then applied this value to each berth	Calculated individual berth emissions according to type	The original emissions inventory summed the emissions from all berth types, and then applied this total value to each berth. This substantially overstated the emissions in the Concept Plan.			X
Maximum truck numbers during construction	57,484 trucks per year	71,760 trucks per year	The maximum number of trucks in any one year during the construction phase was adjusted to reflect updated predicted truck numbers	X		
Ship SO_2 emission factor for auxiliary power engine	0.0000076 kg/kwh	0.0097 kg/kwh	The benzene emission factor was mistakenly applied to SO_2 for auxiliary power engines. Emission factor was corrected.		X	X

Mass Emission Rates

The modifications to the emissions inventory as discussed above changed the calculated mass emission rates. The predicted source mass emission rates of the original assessment and the modified mass emission rates used in this revised assessment are compared below.

Scenario 1a (Major Project Construction) Mass Emission Rates

Original Assessment (11/2/10)

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Dredging Ships	6.04	0.14	0.20	0.18	0.18
Trains (Stockpile)	0.82	0.48	0.00031	0.065	0.065
Trucks	0.032	0.016	0.00010	0.00021	0.00021
Construction Stockpile (Wind Erosion)	0	0	0	0.042	0.083
Construction Stockpile (Active Area)	0	0	0	2.15	5.13
Total	6.85	0.63	0.20	2.43	5.46

Revised Assessment

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Dredging Ships	6.04	0.14	0.20	0.18	0.18
Trains (Stockpile)	**0.60**	**0.35**	**0.00022**	**0.047**	**0.047**
Trucks	**0.11**	**0.056**	**0.00034**	**0.00074**	**0.00074**
Construction Stockpile (Wind Erosion)	0	0	0	0.042	0.083
Construction Stockpile (Active Area)	0	0	0	**0.54**	**1.32**
Total	**6.74**	**0.54**	**0.20**	**0.81**	**1.62**

Bold denotes changes in mass emission rates from the original assessment

Scenario 1b (Major Project Operation) Mass Emission Rates

Original Assessment (11/2/10)

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk Material Ship	1.43	0.12	0.11	0.10	0.10
Trains (Railyard)	0.45	0.26	0.00018	0.036	0.036
Trains (Unloading Siding)	0.66	0.39	0.00030	0.051	0.051
Trucks	0.033	0.017	0.00010	0.00022	0.00022
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.031	0.063
Bulk Material Stockpile (Active Area)	0	0	0	0.99	2.29
Total	2.61	0.79	0.11	1.21	2.54

Revised Assessment

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk Material Ship	1.43	0.12	**1.05**	0.10	0.10
Trains (Railyard)	**0.90**	**0.52**	**0.00034**	**0.071**	**0.071**
Trains (Unloading Siding)	**1.29**	**0.75**	**0.00049**	**0.10**	**0.10**
Trucks	0.033	0.017	0.00010	0.00022	0.00022
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.031	0.063
Bulk Material Stockpile (Active Area)	0	0	0	**0.57**	**1.32**
Total	**3.65**	**1.41**	**1.05**	**0.88**	**1.66**

Bold denotes changes in mass emission rates from the original assessment

Scenario 2 (Concept Plan Operation) Mass Emission Rates

Original Assessment (11/2/10)

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Cargo Ships	22.92	1.86	1.76	1.60	1.60
Trains (Railyard)	1.11	0.66	0.00042	0.090	0.090
Trains (Unloading Siding)	0.96	0.57	0.00036	0.078	0.078
Trains (Container Terminal)	5.20	3.04	0.0019	0.41	0.41
Trucks	0.15	0.075	0.00045	0.0010	0.0010
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.063	0.13
Bulk Material Stockpile (Active Area)	0	0	0	0.99	2.29
Total	30.32	6.15	1.76	3.23	4.59

Revised Assessment

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk Material Berth	**1.43**	**0.12**	**1.05**	**0.10**	**0.10**
Bulk Cargo Berth	**1.43**	**0.12**	**1.05**	**0.10**	**0.10**
Container Berth	**4.10**	**0.33**	**3.01**	**0.29**	**0.29**
Total Ships	***6.97***	***0.56***	***5.11***	***0.49***	***0.49***
Trains (Railyard)	**3.46**	**2.01**	**0.0013**	**0.28**	**0.28**
Trains (Unloading Siding)	**0.45**	**0.26**	**0.00017**	**0.035**	**0.035**
Trains (Container Terminal)	**1.39**	**0.81**	**0.00052**	**0.11**	**0.11**
Trucks	0.15	0.075	0.00045	0.0010	0.0010
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.063	0.13
Bulk Material Stockpile (Active Area)	0	0	0	**0.57**	**1.32**
Total	**14.55**	**4.95**	**5.28**	**1.68**	**2.55**

Bold denotes changes in mass emission rates from the original assessment

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Appendix C

Predicted Impacts Of Scenario 2 (Concept Plan Operation) ‘Normal Operations’

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Scenario 2 (Concept Plan Operation) Results for Predicted Normal Operations

It has been requested by the Department of Planning (DoP) that the Concept Plan operations be modelled under 'normal operations' in addition to the 'peak operating capacity' modelled in the body of this report. Modelling the normal operations is likely to provide a more realistic picture of the actual impacts that the Concept Plan operations will have on the local environment.

The modelling undertaken in the body of the report has identified and applied the peak operating capacity parameters expected during operation. In efforts to present results for normal operations, the following assumptions have been applied to the emissions inventory to predict normal operations. All other data and assumptions provided in the peak operating capacity modelling have been applied in the normal operations modelling. The operational changes and emission rates are provided below:

- Four ships present at the berths per day (1 bulk material berth, 1 general berth and 2 container berths) instead of seven ships per day as modelled for peak operations; and
- The operational times of all Concept Plan trains have been refined to better represent operations, as provided in the following tables. The tables compare the peak operating capacity values and the normal operation values.

Table 38: Normal Operations – Scenario 2 (Concept Plan Operation) Multi-Purpose Berth – Bulk Freight Train Movements

Train Movement	Throttle Level & Time		No. of Locos Modelled
	Peak Operations	Normal Operations	
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Train idles in holding siding then enters loop and unloads adjacent to multi-purpose berth	Idle – 2 hours	Idle – 1 hour	1*
Train leaves via Balloon Loop and North Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Multi-Purpose Berth Bulk Freight - 4 trains per day			

***** Locos may be turned off during selected train operations to conserve fuel.

Table 39: Normal Operations – Scenario 2 (Concept Plan Operation) Multi-Purpose Berth – General Freight Train Movements

Train Movement	Throttle Level & Time		No. of Locos Modelled
	Peak Operations	Normal Operations	
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Train idles in holding siding in South Yard while shunting occurs	Idle – 2 hours	Idle – 1 hour	1*
Train moves to unloading siding adjacent to multi-purpose berth	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	1*
Train idles in unloading siding adjacent to multi-purpose berth while unloading, then shunt & reform in holding siding in South Yard	Idle - 2 hours	Idle – 1 hour	1*
Train leaves holding siding and exit via Balloon Loop and North Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Multi-Purpose Berth General Freight – 1 train per day			

***** Locos may be turned off during selected train operations to conserve fuel.

Table 40: Normal Operations – Scenario 2 (Concept Plan Operation) Container Berth Train Movements

Train Movement	Throttle Level & Time		No. of Locos Modelled
	Peak Operations	Normal Operations	
Train enters holding siding in South Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Train idles in holding siding in South Yard while splitting	Idle – 1 hour	Idle – 30 minutes	2
Train moves to container berth sidings	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Train idles in container berth sidings and returns to holding siding in South Yard to reform before exiting	Idle – 1 hour	Idle – 30 minutes	2
Train leaves from exit siding in South Yard	Throttle 5 – 15 minutes	Throttle 5 – 5 minutes	2
Container Berths – 16 trains per day			

The emission rates used in the normal operations modelling are provided below. Note that the 'No. Of volume Sources' column is for modelling purposes and does not relate to the number of trains, trucks etc.

Table 41: Normal Operations – Scenario 2 (Concept Plan Operation) Modelling Emissions Inventory

Source	ID	Hour / day	Source Type	No. of Volume Sources	Emission Rate				
					NO_x	CO	SO_2	PM_{10}	TSP
					Emission Rate per Volume Source (g/s)				
Bulk material Berth	VS1	24	Volume	1	1.43	0.12	1.05	0.10	0.10
Bulk Cargo Berth	VS3	24	Volume	1	0.72	0.058	0.53	0.050	0.050
Container Berth	VS4 & 7	24	Volume	2	1.02	0.083	0.75	0.071	0.071
Trains (South Railyard)	TR1-3	24	Stack*	3*	0.42	0.24	0.00016	0.033	0.033
Trains (Unloading Siding)	TR4-6	24	Volume	3	0.056	0.032	0.000021	0.0044	0.0044
Trains (Container Terminal)	VS8-15	24	Volume	8	0.062	0.036	0.000023	0.0049	0.0049
Trucks	VS16-25	24	Volume	10	0.015	0.0075	0.000045	0.00010	0.00010
					Emission Rate per Area Source ($g/m^2.s$)				
Bulk Material Stockpile (Wind Erosion)	OPSSTK	24	Area	NA	0	0	0	0.0000028	0.0000056
Bulk Material Stockpile (Active Area)	ACTSTK	24	Area	NA	0	0	0	0.00025	0.00059

- * Trains in the South Yard have been included in the modelling as separated stack sources. To calculate the mass emission rate multiply the pollutant emission rate by the number of stacks.

The values in **Table 41** have been modified in regards to the number of bulk cargo and container volumes sources modelled, source type for the South Yard and the emission rates for all the train sources.

Table 42: Normal Operations – Scenario 2 (Concept Plan Operation) Mass Emission Rates

Source	Mass Emission Rate (g/s)				
	NO_x	CO	SO_2	PM_{10}	TSP
Bulk material Berth (1 berth modelled)	1.43	0.12	1.05	0.10	0.10
Bulk Cargo Berth (1 berth modelled)	0.72	0.06	0.53	0.05	0.05
Container Berth (2 berths modelled)	2.05	0.17	1.50	0.14	0.14
Trains (South Railyard)	1.26	0.73	0.0005	0.10	0.10
Trains (Unloading Siding)	0.17	0.10	0.00006	0.013	0.013
Trains (Container Terminal)	0.50	0.29	0.00019	0.04	0.04
Trucks	0.15	0.075	0.00045	0.0010	0.0010
Bulk Material Stockpile (Wind Erosion)	0	0	0	0.063	0.13
Bulk Material Stockpile (Active Area)	0	0	0	0.57	1.32
TOTAL Normal Operation	**6.27**	**1.53**	**3.08**	**1.08**	**1.89**
Total Peak Capacity	*12.41*	*3.72*	*5.11*	*1.54*	*2.35*

The predicted Scenario 2 pollutant GLCs are provided in the below tables. Where background data are available, the predicted cumulative pollutant GLCs (predicted GLC plus the background concentration) are provided in brackets. Where applicable (PM_{10} results), the additional number of exceedences beyond that already measured in the background data have been provided in square brackets. Note that deposited dust results are expressed as deposition rates and not concentrations.

Table 43: Normal Operations – Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for PM_{10}, TSP and Dust Deposition

Receptor Number	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust Deposition (g/m^2.month)
	24 Hour	Annual	Annual	Annual
1	14 (**66**) [1]	0.5 (21)	1.1 (50.1)	0.07
2	20 (**71**) [8]	1.4 (22)	3.0 (52.0)	0.19
3	56 (**86**) [24]	5.7 (27)	12.8 (61.8)	0.67
4	35 (**80**) [6]	3.7 (25)	8.4 (57.4)	0.25
5	33 (**73**) [2]	2.5 (23)	5.5 (54.5)	0.15
6	16 (**65**) [3]	1.5 (22)	3.3 (52.3)	0.09
7	22 (**68**) [0]	1.5 (22)	3.3 (52.3)	0.09
8	23 (**75**) [4]	2.5 (23)	5.5 (54.5)	0.16
9	26 (**67**) [6]	2.6 (23)	5.6 (54.6)	0.25
10	20 (**70**) [6]	1.3 (22)	2.7 (51.7)	0.15
Criteria	50	30	90	2

Bold denotes exceedences of criteria

Table 44: Normal Operations – Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for NO_2 and SO_2

Receptor Number	Nitrogen Dioxide (NO_2) ($\mu g/m^3$)		Sulfur Dioxide (SO2) ($\mu g/m^3$)			
	1 Hour	Annual	10min	1 hour	24 hour	Annual
1	73 (105)	1 (19)	73	62 (214)	5 (48)	0.5 (3.5)
2	85 (106)	3 (21)	97	87 (239)	8.7 (51.7)	0.8 (3.8)
3	82 (103)	4 (22)	120	107 (259)	8.9 (51.9)	1.6 (4.6)
4	75 (101)	3 (21)	116	99 (251)	9.3 (52.3)	1.4 (4.4)
5	73 (101)	2 (20)	111	99 (251)	10.2 (53.2)	1.3 (4.3)
6	65 (101)	2 (20)	140	120 (272)	10.6 (53.6)	1.1 (4.1)
7	63 (100)	2 (20)	125	106 (258)	10.3 (53.3)	1 (4)
8	75 (99)	2 (20)	100	89 (241)	7.3 (50.3)	1.1 (4.1)
9	68 (102)	3 (21)	92	79 (231)	6.6 (49.6)	1.2 (4.2)
10	90 (108)	2 (20)	97	78 (230)	7.1 (50.1)	0.7 (3.7)
Criteria	246	62	712	570	228	60

Bold denotes exceedences of criteria

Table 45: Normal Operations – Scenario 2 (Concept Plan Operation) Maximum Predicted GLC at the Discrete Sensitive Receptors for CO

Receptor Number	Carbon Monoxide (CO) ($\mu g/m^3$)		
	15 Minutes	1 hour	8 Hours
1	95	75 (4325)	20 (3270)
2	108	89 (4339)	29 (3279)
3	100	76 (4326)	22 (3272)
4	93	71 (4321)	22 (3272)
5	87	67 (4317)	20 (3270)
6	77	59 (4309)	18 (3268)
7	73	56 (4306)	16 (3266)
8	87	67 (4317)	17 (3267)
9	91	73 (4323)	29 (3279)
10	110	92 (4342)	36 (3286)
Criteria	100,000	30,000	10,000

Bold denotes exceedences of criteria

The normal operation modelling results above show that all pollutants have decreased when compared against the original modelling results (peak operating capacity), with only PM_{10} exceeding the criteria. The PM_{10} results decreased marginally, with the number of additional exceedences beyond that already measured in the background data also decreasing slightly (although not at Receptor 3, the most impacted receptor, which remained at 24 exceedences) This is not unexpected as a review of the mass emission rates from the Concept Operations suggests that the major dust contributor is the stockpiles. The stockpile assumptions were the same for both the normal and peak modelling options.

The modelling results for the normal operations of the Concept Plan show that with the exception of 24 hour average PM_{10}, all modelled pollutants met the DECCW criteria at the discrete sensitive receptors. The predicted PM_{10} GLCs show that there are likely to be exceedences in addition to the number of exceedences that already occur in the Wollongong air shed. There were no exceedences of the PM_{10} annual average criteria.

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Appendix D

Example AUSPLUME File

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PKOHD Modelling Major OPS

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Averaging time for sigma-theta values	60 min.

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Sigma-theta
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

(Stability Class: A–F)

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
average over all hours

1

SOURCE CHARACTERISTICS

INTEGRATED AREA SOURCE: OPSTK

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
307416	6183625	0m	100m	225m	-30deg	5m	0m

(Constant) emission rate = 0.00E+00 grams/second per square metre
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: ACTSTK

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
307416	6183625	0m	100m	23m	-30deg	5m	0m

(Constant) emission rate = 0.00E+00 grams/second per square metre
No gravitational settling or scavenging.

VOLUME SOURCE: VS2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307608	6183721	0m	35m	1m	1m

(Constant) emission rate = 1.07E+00 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
306843	6182940	0m	3m	1m	1m

(Constant) emission rate = 6.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR2

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
306861	6182934	0m	3m	1m	1m

(Constant) emission rate = 6.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR3

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
306880	6182927	0m	3m	1m	1m

(Constant) emission rate = 6.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR4

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307230	6183538	0m	3m	1m	1m

(Constant) emission rate = 1.00E-04 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR5

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307240	6183521	0m	3m	1m	1m

(Constant) emission rate = 1.00E-04 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: TR6

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307249	6183503	0m	3m	1m	1m

(Constant) emission rate = 1.00E-04 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS20

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307372	6183386	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS21

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307323	6183469	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS22

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307272	6183554	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS23

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307215	6183639	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS24

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307166	6183725	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

VOLUME SOURCE: VS25

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
307118	6183811	0m	2m	47m	0m

(Constant) emission rate = 2.00E-05 grams/second
No gravitational settling or scavenging.

1 ______________________________________

RECEPTOR LOCATIONS

____

The Cartesian receptor grid has the following x-values (or eastings):

305271.m 305371.m 305471.m 305571.m 305671.m 305771.m 305871.m

305971.m 306071.m 306171.m 306271.m 306371.m 306471.m 306571.m
306671.m 306771.m 306871.m 306971.m 307071.m 307171.m 307271.m
307371.m 307471.m 307571.m 307671.m 307771.m 307871.m 307971.m
308071.m 308171.m 308271.m 308371.m 308471.m 308571.m 308671.m
308771.m 308871.m 308971.m 309071.m 309171.m 309271.m 309371.m
309471.m 309571.m 309671.m 309771.m 309871.m 309971.m 310071.m
310171.m 310271.m

and these y-values (or northings):
6181050.m 6181150.m 6181250.m 6181350.m 6181450.m 6181550.m 6181650.m
6181750.m 6181850.m 6181950.m 6182050.m 6182150.m 6182250.m 6182350.m
6182450.m 6182550.m 6182650.m 6182750.m 6182850.m 6182950.m 6183050.m
6183150.m 6183250.m 6183350.m 6183450.m 6183550.m 6183650.m 6183750.m
6183850.m 6183950.m 6184050.m 6184150.m 6184250.m 6184350.m 6184450.m
6184550.m 6184650.m 6184750.m 6184850.m 6184950.m 6185050.m 6185150.m
6185250.m 6185350.m 6185450.m 6185550.m 6185650.m 6185750.m 6185850.m
6185950.m 6186050.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	305867	6183063	0.0	0.0	6	308018	6182170	0.0	0.0
2	306366	6182787	0.0	0.0	7	307910	6181866	0.0	0.0
3	307138	6182789	0.0	0.0	8	307436	6182023	0.0	0.0
4	307525	6182409	0.0	0.0	9	306988	6182290	0.0	0.0
5	307690	6182206	0.0	0.0	10	306211	6182431	0.0	0.0

METEOROLOGICAL DATA : Metdata Wollongong 1 July 2006 - 21 June 2007

Appendix E

Example Variable Emissions Input File

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PKOHD Emission Rates Major Project; Construction - CO
12,'DR1',3,'TR7',3,'TR8',3,'TR9',3,'VS20',3,'VS21',3,'VS22',3,'VS23',3,'VS24',3,'VS25',3,'CONSTK',2,'ACTSTK',2
06070101,1.38E-01,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00
06070102,1.38E-01,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00
06070103,1.38E-01,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00
06070104,1.38E-01,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00
06070105,1.38E-01,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00,0.00E+00
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Appendix F

Slag Exemption Screening Assessment Results

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TSP Slag Exemption Screening Assessment for Major Project Construction

	The Blast Furnace Slag Exemption 2010			Major Project Construction Annual Predicted at highest Discrete Receptor			DECCW Criteria	Major Project Construction 1 Hour Predicted at highest Discrete Receptor			DECCW Criteria
Chemicals and other attributes	**Maximum average conc. for characterisation**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**Maximum average conc. for characterisation**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**Annual**	**Maximum average conc. for characterisation**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**1 hour**
	mg/kg	**mg/kg**	**mg/kg**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Mercury	0.5	Not Required	1	0.0000001	NA	0.0000002	NA	0.00001	NA	0.00002	1.8
Cadmium	0.5	0.5	1	0.0000001	0.0000001	0.0000002	NA	0.00001	0.00001	0.00002	0.018
Lead	10	10	20	0.0000018	0.0000018	0.0000036	0.5	0.00016	0.00016	0.00032	NA
Arsenic	5	Not Required	10	0.0000009	NA	0.0000018	NA	0.00008	NA	0.00016	0.09
Beryllium	10	Not Required	20	0.0000018	NA	0.0000036	NA	0.00016	NA	0.00032	0.004
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (total)	50	Not Required	100	0.0000090	NA	0.0000180	NA	0.00080	NA	0.00159	0.09
Copper	10	Not Required	20	0.0000018	NA	0.0000036	NA	0.00016	NA	0.00032	18
Molybdenum	5	5	10	0.0000009	0.0000009	0.0000018	NA	0.00008	0.00008	0.00016	NA
Nickel	10	Not Required	20	0.0000018	NA	0.0000036	NA	0.00016	NA	0.00032	0.18
Selenium	2	Not Required	5	0.0000004	NA	0.0000009	NA	0.00003	NA	0.00008	NA
Zinc	25	25	50	0.0000045	0.0000045	0.0000090	NA	0.00040	0.00040	0.00080	90

Slag Stockpile Max TSP Ann. Avg. Conc. = 0.180 ug/m3 (in isolation from background)
Slag Stockpile Max TSP 1 Hr. Avg. Conc. = 15.90 ug/m3 (in isolation from background)

PM_{10} Slag Exemption Screening Assessment for Major Project Construction

	The Blast Furnace Slag Exemption 2010			Major Project Construction Annual Predicted at highest Discrete Receptor			DECCW Criteria	Major Project Construction 1 Hour Predicted at highest Discrete Receptor			DECCW Criteria
Chemicals and other attributes	**Maximum average conc. for characterisation**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**Maximum average conc. for characterisation**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**Annual**	**Maximum average conc. for characterisatio n**	**Maximum average conc. for routine testing**	**Absolute maximum conc.**	**1 hour**
	mg/kg	**mg/kg**	**mg/kg**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Mercury	0.5	Not Required	1	0.00000005	NA	0.0000001	NA	0.000004	NA	0.000008	1.8
Cadmium	0.5	0.5	1	0.00000005	0.0000000	0.0000001	NA	0.000004	0.000004	0.000008	0.018
Lead	10	10	20	0.0000009	0.0000009	0.0000018	0.5	0.00008	0.00008	0.0002	NA
Arsenic	5	Not Required	10	0.0000005	NA	0.0000009	NA	0.00004	NA	0.00008	0.09
Beryllium	10	Not Required	20	0.0000009	NA	0.0000018	NA	0.000080	NA	0.00016	0.004
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (total)	50	Not Required	100	0.0000045	NA	0.0000090	NA	0.00040	NA	0.00080	0.09
Copper	10	Not Required	20	0.0000009	NA	0.0000018	NA	0.000080	NA	0.0002	18
Molybdenum	5	5	10	0.0000005	0.0000005	0.0000009	NA	0.00004	0.00004	0.00008	NA
Nickel	10	Not Required	20	0.0000009	NA	0.0000018	NA	0.00008	NA	0.00016	0.18
Selenium	2	Not Required	5	0.0000002	NA	0.0000005	NA	0.00002	NA	0.00004	NA
Zinc	25	25	50	0.0000023	0.0000023	0.0000045	NA	0.0002	0.0002	0.0004	90

Slag Stockpile Max PM10 Ann. Avg. Conc. = 0.09 ug/m3 (in isolation from background)
Slag Stockpile Max PM10 1 Hr. Avg. Conc. = 7.95 ug/m3 (in isolation from background)

Worldwide Locations

Australia	+61-2-8484-8999
Azerbaijan	+994 12 4975881
Belgium	+32-3-540-95-86
Bolivia	+591-3-354-8564
Brazil	+55-21-3526-8160
China	+86-20-8130-3737
England	+44 1928-726006
France	+33(0)1 48 42 59 53
Germany	+49-631-341-13-62
Ireland	+353 1631 9356
Italy	+39-02-3180 77 1
Japan	+813-3541 5926
Malaysia	+603-7725-0380
Netherlands	+31 10 2120 744
Philippines	+632 910 6226
Scotland	+44 (0) 1224-624624
Singapore	+65 6295 5752
Thailand	+662 642 6161
Turkey	+90-312-428-3667
United States	+1 978-589-3200
Venezuela	+58-212-762-63 39

Australian Locations

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Canberra
Darwin
Melbourne
Newcastle
Perth
Sydney
Singleton

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