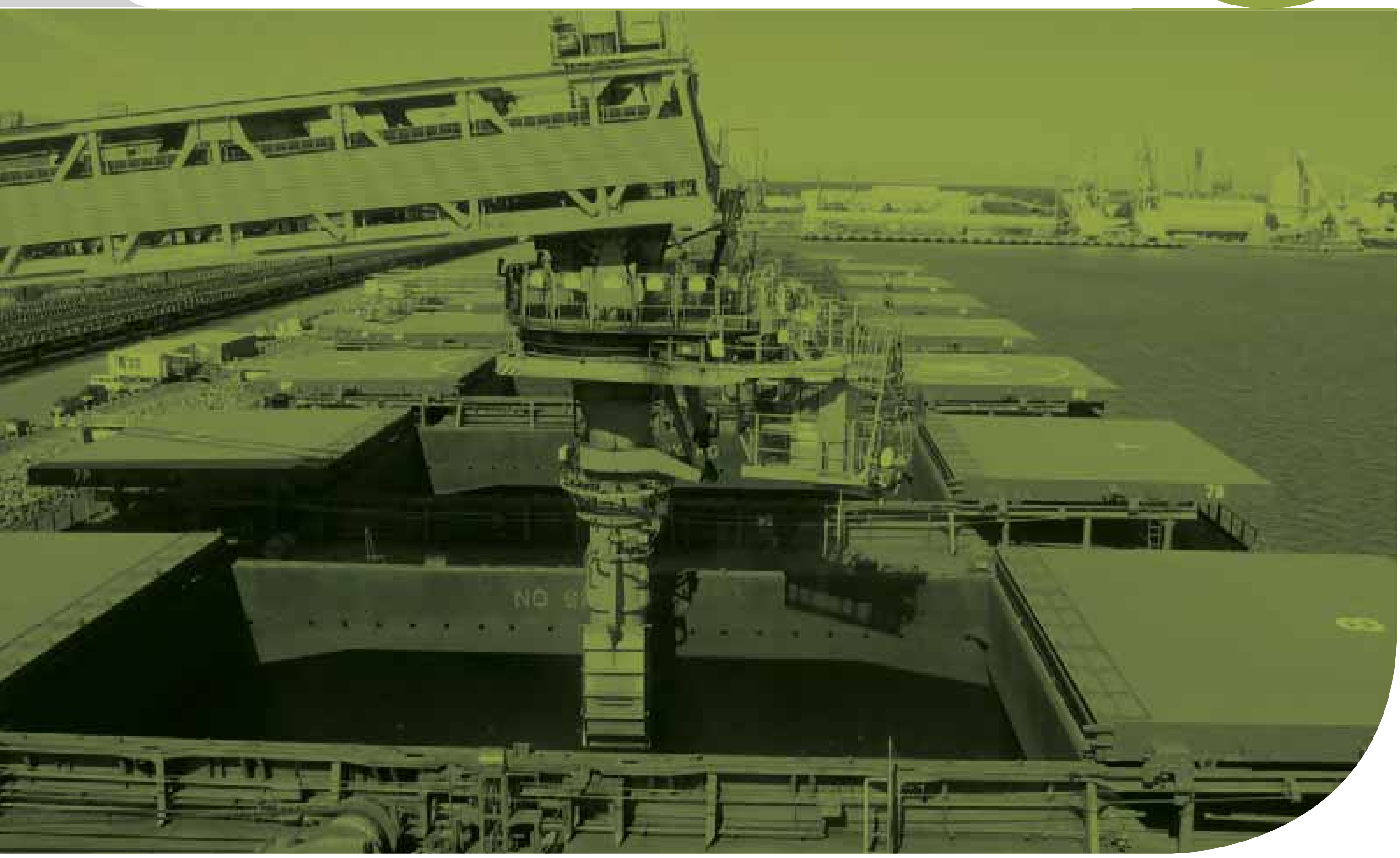
# APPENDIX C

## ENVIRON'S RESPONSE TO AIR QUALITY MATTERS



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# PWCS Terminal 4 Project – Response to Submissions on the Air Quality Assessment

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This document is issued to Port Waratah Coal Services c/o EMGA Mitchell McLennan for the purposes of providing a response to submissions made in relation to the Air Quality Assessment of the Port Waratah Coal Services Terminal 4 Project, as part of the Environmental Assessment of the T4 Project under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and Part 3A of the *NSW Environmental Planning and Assessment Act 1979*. It should not be used for any other purpose.

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# 1 Introduction

Port Waratah Coal Services Limited (PWCS) proposes to construct and operate a new coal export terminal at the Port of Newcastle, New South Wales. The proposal, known as the Terminal 4 Project (T4 Project), will provide additional port capacity required to accommodate the projected future growth in coal exports from the Hunter Valley and broader NSW.

Approval for the T4 Project is being sought under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Commonwealth has accredited the State's Part 3A process as the appropriate commonwealth assessment pathway.

As part of the approval process an environmental assessment (EA) for the T4 Project was prepared by EMGA Mitchell McLennan Pty Limited (EMM), with input from other consulting companies. This included an Air Quality Assessment by ENVIRON Australia Pty Ltd (ENVIRON). The draft EA was lodged with the NSW Department of Planning and Infrastructure (DP&I) for adequacy review on 30th November 2011. Following government feedback it was modified and the DP&I then deemed that it adequately met the requirements for an EA and could proceed to public exhibition. The final EA was publicly exhibited from 8th March to 7th May 2012. The Air Quality Assessment was issued by ENVIRON on 17 February 2012 (ENVIRON, 2012a). This document constitutes Appendix M of Volume 5 of the EA for the T4 Project (EMM, 2012).

In response to the publicly exhibited EA, PWCS received 488 submissions on the project, including a large number of form letters and multiple submissions by some respondents. Submissions were received from stakeholder groups, including government, non-governmental organisations (NGOs), community groups, business and individuals. ENVIRON was commissioned by PWCS to review the relevant stakeholder submissions and provide responses to issues raised in relation to air quality and the Air Quality Assessment. This report sets out ENVIRON's responses and provides supplementary information where appropriate.

Since the publication of the EA there have been some modifications to the project. These have been in response to submissions and government feedback, to further minimise environmental impacts and to incorporate engineering improvements. ENVIRON was engaged by PWCS to assess the implications of the design modifications for the air quality assessment results in the EA, as part of the combined Response to Submissions/Preferred Project Report (RTS/PPR). The Air Quality Assessment conducted for the Modified T4 Project is documented in a separate report (ENVIRON, 2013) in Appendix O of the RTS/PPR. The outcomes and recommended air quality and dust management and monitoring measures are generally consistent with the EA.

This report outlining the response to air quality related submissions on the EA should be read in conjunction with the Air Quality Assessment in the EA (ENVIRON, 2012a), which remains the primary reference document, and the Air Quality Assessment for the Modified T4 Project (ENVIRON, 2013).

# 2 Scope of Work

The scope of works for the review of submissions was as follows:

- Review all submissions received on air quality and the Air Quality Assessment Report compiled for the T4 Project, as received from EMGA Mitchell McLennan.
- Where appropriate, address issues contained within submissions by referencing the relevant section of the report(s) addressing the issues raised, for example the EA.
- Where an issue is considered to require the provision of clarifications or further information, address these issues in more detail and cross-reference the response with the relevant submission numbers.

To facilitate the review of submissions and to flag the relevant issues, EMGA Mitchell McLennan, on behalf of PWCS, provided ENVIRON with a spreadsheet categorising and summarising issues based on a screening level check of the submissions. This was used as the basis for identifying submissions where issues in relation to the Air Quality Assessment, air emissions and/or air quality were raised. ENVIRON reviewed these submissions in detail to ascertain the context in which the issue was raised and the exact nature of the issue; as well as to understand the extent of overlap of issues and to identify dominant issues/themes to be addressed.

# 3 Overview of Submissions in Relation to Air Quality

## 3.1 Number of Responses

488 submissions in response to the T4 Project Public Exhibition were received by PWCS, of which a significant number of submissions specifically raised one or more issues in relation to air emissions, air quality, air quality related impacts, air quality assessment and/or general health concerns. These submissions included submissions from individuals, businesses, political groups, non-government organisations and government agencies, including the Office of Environment and Heritage (OEH)/Environment Protection Authority (EPA), Hunter New England Local Health District, Newcastle City Council and Singleton Council.

## 3.2 Prevalent Issues

Issues raised and statements made in relation to air quality were grouped together where they were of a similar nature, and the relative prevalence of issues noted. The following perceived issues were raised in relation to air quality and health:

- Air quality assessment:
  - Scope or approach
  - Baseline air quality characterisation
  - Assessment of impacts
- Existing air quality:
  - Existing air quality related health impacts
  - Existing dust levels
  - Available air quality monitoring
- T4 Project related issues:

  - Air quality impacts (generally stated)
  - Coal dust / dust / particles
  - Control measures to be implemented
  - Rail and shipping emissions
  - Mobilisation of toxic contaminants
  - Health impacts related to coal dust, ultra-fine particles, diesel exhaust or gases
  - Amenity impacts related to dust or odour
- Cumulative rail corridor impacts
- Upstream impacts of coal mining
- Downstream impacts of coal combustion
- Health impacts related to climate change
- General health concerns
- Calls for cumulative health impact assessment

The matters most commonly raised in respect of air quality related to perceived poor existing air quality and dust levels in the region; concerns about the assessment scope, methodology and adequacy; cumulative impacts along the rail corridor; and air quality and associated health impacts, including coal dust, dust and fine particulate matter impacts.

# 4 Responses to Submissions

Issues raised within the 488 submissions, as inventoried within an Excel spreadsheet by EMGA Mitchell McLennan, were received by ENVIRON together with copies of each individual submission. Air quality and health risk related issues raised within submissions were identified and consolidated into key issues. This was done to provide a complete understanding of concerns and to enable issues to be more comprehensively addressed within this report. This report should be read with reference to the *Air Quality Assessment for the Terminal 4 Project,* dated 17 February 2012 (Appendix M in the EA, hereafter the 'Air Quality Assessment' and 'AQIA') and the *PWCS Terminal 4 Project – Air Quality Assessment for Modified Project*, dated March 2013 (Appendix O in the RTS/PPR).

Responses to the key issues raised in relation to air quality are provided in subsequent subsections. Cross-reference has been made to the submissions in several cases.

## 4.1 Upstream and Downstream Air Quality Impacts

| Submissions called for the assessment of:<br>• Upstream impacts of coal mining in the Hunter region,<br>• Downstream impacts of coal combustion, and/or<br>• Health impacts related to climate change. |
|---|

The scope of the air quality assessment was in accordance with the Director General's Environmental Assessment Requirements (EARs) in respect of air quality (as outlined in **Section 1.2** of the AQIA Report) and the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("Approved Methods for Modelling", OEH 2005). The T4 Project application is for a coal terminal at the Port of Newcastle and does not include upstream or downstream activities. Accordingly, the assessment of upstream impacts from coal mining, downstream impacts from coal combustion and indirect health effects arising due to climate change fall outside of the scope of the T4 Project environmental assessment. Coal mining and coal combustion projects are addressed by separate assessment and approval processes, by the regulators and proponents of these projects. Further response in the context of greenhouse gases (GHGs) is provided in Chapter 9 of the EMM (2013) RTS/PPR.

In its submission, EPA confirms that the air quality assessment has been conducted generally in accordance with the Approved Methods for Modelling with no requirement to expand the scope or alter the method applied (Submission reference G441).

## 4.2 Air Pollutants Assessed

Several submissions enquire whether specific air pollutants were addressed in the assessment or state that certain pollutants were omitted from the assessment. Reference is made to coal dust, gases from fossil fuel combustion, diesel exhaust particles, odours ('smelly gases') and fine particles. In regard to particulate matter, specific reference is made to the following particle size fractions: total suspended particulates (TSP), particulate matter with an aerodynamic diameter of less than ten micrometres ($PM_{10}$), $PM_{2.5}$, $PM_1$ and $PM_{0.1}$.

General information on airborne particle sizes, sources, atmospheric residence times and removal mechanisms is given in **Appendix B** of this report as background information to support the response to submissions.

The AQIA report included the assessment of the following air pollutants: particulate matter (including TSP, $PM_{10}$, and $PM_{2.5}$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), sulphur dioxide ($SO_2$), benzene, toluene, ethylbenzene, and total xylene (BTEX). In addressing particulate matter specific reference was made to coal dust and diesel combustion particles. Whereas a range of organic compounds are released from the combustion of diesel fuel, the study focused primarily on BTEX to assess the potential health impact of individual organic species. These species are quantifiable based on available emission factors, and may be used as markers of the relative toxicity of organic compounds from combustion. Combustion related emissions from fuel consumption by sea going vessels, rail locomotives and stationary and mobile plant in the T4 project area were accounted for (Refer to **Section 6** and **Appendix D** in the AQIA Report). GHGs were also quantified and assessed (refer EA Appendix N and RTS/PPR Appendix P).

$PM_1$ and ultra fine particles ($PM_{0.1}$) were not included in the assessment given that no air quality standards are published for these particle size fractions within NSW, inter-state, nationally or internationally. Although evidence for health effects linked to ultrafine particles has been found, it has been concluded that there is not sufficient evidence to support the setting of standards at this time (NEPC, 2011; US-EPA, 2009, 2011; WHO, 2006, 2007). NEPC (2011, p. 27) notes that there is not sufficient evidence at this time to show any independent effect of ultrafine particles. Additionally, ultrafine particles are not routinely monitored, and there is no monitoring data available in Australia that would enable the setting of standards (NEPC, 2011, p. 22).

A review was undertaken to identify potential sources of odour during the construction and operational phases of the T4 Project. No odour sources were identified as occurring during the operational stages. Based on the description of construction activities, the potential for odour emissions occurring during the construction phase was evaluated to be minor. Odour emissions and impacts were therefore not quantitatively assessed.

## 4.3 Sources Assessed

Some submissions state that impacts from the following air emission sources were not accounted for in the assessment:

- Coal stockpiles.
- Locomotives (coal dust and diesel exhaust emissions).
- Sea transport.
- Venting and/or flaring of natural gas during commissioning of the new pipeline.

The air quality assessment quantified, modelled and assessed air emissions from coal stockpiles, rail locomotives and marine vessels in the T4 project area, as well as the other sources described in the EA (Refer to **Section 6, Appendix D** and **Appendix F** in the AQIA Report). Coal dust from rail wagons and combustion exhaust emissions from diesel-powered rail locomotives were quantified.

The air quality assessment included the quantification of emissions from rail locomotives accessing the T4 project area and releases related to idling and other operations whilst trains are in the T4 project area. The potential for coal dust emissions from rail wagons operating along the rail corridor was assessed, however exhaust emissions from rail locomotives were not quantified along the entire rail corridor. Off-site coal chain activities, including rail transport of coal from the mines to the terminal, are beyond PWCS's control. Impacts of trains on the Hunter Valley rail corridor outside the T4 project area are assessed and managed by the Australian Rail Track Corporation (ARTC) and rail freight operators as part of the license conditions and approval and assessment requirements for these activities.

Combustion emissions from the auxiliary engines and boilers of marine vessels whilst at berth were also quantified and included in the assessment. Emissions from marine propulsion engines during the transit of vessels into and out of port were not quantified. Off-site coal chain activities, including shipping, are beyond PWCS's control. Impacts of these activities are assessed and managed by others, separate to the T4 Project's assessment and approvals processes. In the case of ship movements in Newcastle Harbour, this is by NPC and the shipping companies.

The potential for venting and/or flaring of natural gas during commissioning of the new pipeline was raised in Jemena's submission in respect of the EA. No data are available on which to base a quantitative assessment of the air quality impacts of this activity. However, Jemena has indicated that the venting or flaring of natural gas will be minimal and restricted to the commissioning phase of the new pipeline. PWCS is liaising with Jemena about the proposed gas pipeline relocation works.

## 4.4 Modelling of Coal Dust from Rail Wagons

The following issues were raised in regard to the manner in which coal dust emissions from rail wagons were assessed:

- Only air quality issues around rail transport to the Port are considered, not rail locomotives returning to the Upper Hunter Valley.
- Only rail dust impacts on residences within 20m on the rail line are considered; impacts are likely to extend beyond this.
- Concentrations should be modelled up to 300m from the rail line.
- Concentrations should be modelled within a 2km radius of the rail corridor.

Coal dust emissions from rail wagons were assessed to determine the potential for coal dust impacts along the rail corridor. The literature indicates that when coal dust emissions do occur, such emissions tend to emanate primarily from coal loads (Connell Hatch, 2008). The assessment thus focused on loaded coal trains (and hence train movements towards the port).

Maximum airborne particle concentrations were modelled to evaluate peak concentrations occurring in the immediate vicinity of the rail line, and the reduction in such concentrations with distance from the rail line. Airborne particle concentrations were modelled at distances of 20m, 40m, 80m and 120m away from the rail line with a significant reduction in concentrations being predicted beyond 20m from the railway line. This assessment is documented in **Appendix F** of the AQIA Report and updated in Appendix O of the RTS/PPR. The study findings were consistent with the findings of the comprehensive Connell Hatch (2008) investigation.

The airborne particle concentrations are predicted to significantly decrease away from the rail line. When discussing the airborne particle concentrations predicted to occur, reference was conservatively made within the main body of the AQIA Report to the peak concentrations predicted in close proximity (within 20m) of the rail line. This is likely to have resulted in the overall assessment approach having been misconstrued.

## 4.5 Cumulative Rail Corridor Assessment

A number of submissions call for a cumulative assessment to be conducted for the rail corridor including consideration of:

- Impacts along the entire rail corridor from the Upper Hunter Valley to the terminal.
- All possible air emission sources including:
  - Coal dust from loaded and empty wagons;
  - Coal dust from re-entrainment of deposited dust by freight and passenger locomotives; and
  - Diesel exhaust emissions from coal, other freight and passenger locomotives.
- Consideration of $PM_{10}$, $PM_{2.5}$, diesel combustion pollutants and ultra fine particles.
- Integrated assessment of air pollution, noise, vibration, health and sleep disturbance.

- T4 related rail together with all other rail, and the projected growth of such rail activity.
- Effects on people living in close proximity to the rail corridor, and urban precincts transected by rail such as Newcastle and Maitland.

As indicated previously, the scope of the air quality assessment was in accordance with the Director General's EARs in respect of air quality (as outlined in **Section 1.2** of the AQIA Report) and the OEH 2005 *Approved Methods for the Modelling*. A cumulative assessment of overall impacts within the entire rail corridor falls outside of the scope of the T4 Project environmental assessment.

The management of dust and other air emissions from rail wagons outside of the T4 project area is the responsibility of ARTC and rail freight operators. To meet Pollution Reduction Program (PRP) requirements placed on its Environmental Protection Licence by the NSW EPA, ARTC recently commissioned a pilot study to quantify the level of dust (fine particulates: $PM_{10}$ and $PM_{2.5}$) generated from the rail transport of coal and other freight in the Newcastle area rail corridor (ENVIRON, 2012b). Particulate matter concentration monitoring was undertaken during February/March 2012 at two locations; one at Scholey Street Junction in Mayfield, and a second site located off Raymond Terrace Drive at Metford. Monitoring devices were positioned in proximity to the track to capture particle emissions from passing trains (3m from nearest rail track). TSP, $PM_{10}$ and $PM_{2.5}$ concentrations measured to coincide with train passes were analysed by train type, accounting for loaded coal trains, unloaded coal trains, passenger trains and freight trains.

According to findings from the ARTC study, when compare to 'no train' periods, coal train pass by periods were measured to increase $PM_{10}$ concentrations in the immediate vicinity by on average 2.2 $\mu g/m^3$ at Mayfield and 4.8 $\mu g/m^3$ at Metford (ENVIRON, 2012b). Concentrations for loaded and unloaded coal train passes were found to be comparable to freight train passes across particle size fractions (ENVIRON, 2012b). Thus coal trains were not found to result in higher particle concentrations when compared to freight trains. Findings from the comparison of concentrations coinciding with coal train and passenger train passes were more mixed. Whereas passenger trains coincided with higher maximum concentrations compared to coal train passes, average and median TSP and $PM_{10}$ concentrations were measured to be higher for coal train passes (only marginally higher in the case of Mayfield) (ENVIRON, 2012b). It is estimated that 57 loaded coal trains were required to operate on average each day during 2012 to meet coal transfer requirements (ARTC, 2012).

OEH commissioned a study to identify measures to reduce $PM_{10}$, $PM_{2.5}$ and NOx emissions from new and in-service locomotives in NSW and Australia (OEH, 2012d). The study focuses on diesel and diesel-electric locomotives – including switching and main line locomotives, and including passenger and freight locomotives. Key components of the study include: the review of local, national and international air emission regulation and policies for new and in-service locomotives; characterization of the locomotive fleet industry in NSW and Australia, quantification of air emissions from locomotives in NSW and Australia, and identification of potential cost-effective measures for reducing air emissions from new and in-service locomotives in NSW and Australia. The findings of this study are due to be released in 2013.

## 4.6 Assessment of Cumulative Air Quality Impacts

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| Some submissions enquire whether cumulative air pollution impacts are accounted for in the T4 Project air quality assessment. |

Cumulative air quality modelling and assessment was undertaken for the T4 Project, integrating existing air quality, as measured at several stations during 2010, in addition to predicted incremental air pollutant concentrations/ deposition rates due to approved future developments and additional proposed developments (not yet approved) that DP&I requested be considered. This modelling facilitated an evaluation of the T4 Project against OEH ambient air quality impact assessment criteria applicable to cumulative air pollutant concentrations. Reference was made to air pollutant concentrations for 2010 given that this was the latest complete year of data available at the time of the assessment. The baseline characterisation is documented in **Section 5** of the AQIA Report, with results from the cumulative air quality assessment presented in **Section 8** and updated in the assessment of the modified project in **Appendix O** of the RTS/PPR.

## 4.7 Baseline Air Quality Characterisation

Issues raised in regard to the completeness and validity of the air quality and emissions data used in the air quality assessment for baseline air quality characterisation to facilitate the cumulative impact assessment are summarised as follows:

- Use of air quality monitoring data for 2010 resulted in baseline air pollution levels being underestimated.
- Existing air quality monitoring is inadequate.
- Increments in future air pollution concentrations due to approved developments are underestimated.
- Existing air quality in the region is poor and is associated with existing impacts on health and amenity.
- Some existing pollution levels exceed World Health Organisation (WHO) guidelines and have not been fully investigated.

The above issues are addressed in the following subsections.

### 4.7.1 Rational for Using 2010 Air Quality Data in Cumulative Analysis

**Issue:** The air quality levels for 2010 are lower than levels recorded in other years. It would be more valid to average levels across all available years. Justification should be provided for using 2010 air quality levels.

The baseline air quality characterisation approach is documented in **Section 5** of the AQIA Report. Although air quality monitoring data for 2010 was used in the modelling, an analysis was conducted of all available data to discern longer term trends to inform the baseline characterisation. Up to a decade of data was analysed where available.

Air quality monitoring data from 2010 was used for the following reasons:

- It was the latest complete year of data available at the time of the assessment, and therefore indicative of existing air quality.
- It coincided with the meteorological model year selected for the study, making it possible to undertake dispersion modelling to robustly project increments in air pollution levels due to future developments on a time-resolved basis.
- Reference was made to continuous monitoring data to supplement the 1-in-six day sampling. Continuous monitoring data from the HDC station at Mayfield were only available for recent years.
- There has been a significant reduction in airborne particulate matter concentrations in the region since the late 1990s, due in part to the closure of BHP's operations. This trend was evident in the long term data sets analysed during the air quality assessment, and is also documented within OEH (2012b). Based on the entire data analysis, air quality in 2010 was considered to be fairly representative of post-2006 air quality in the region (excluding the substantial regional dust storm related concentrations in 2009 which are atypical).
- Air quality monitoring data were available for more monitoring sites during 2010 than for any previous year.

**Sensitivity Analysis**

In response to the submissions, additional sensitivity analysis was undertaken to assess whether the air quality assessment outcomes would be substantially altered through the application of air quality data from other recent years. Air quality monitoring data were obtained for 2011 to support such analysis and ensure that the most current complete year of data is used.

Given the significant reduction in airborne particulate matter concentrations in the region, evident from data presented within **Section 5** of the AQIA Report and within OEH (2012b), air quality data for the more recent 5 year period (2007 to 2011) were analysed to account for inter-annual variations in air pollutant concentrations. TSP, $PM_{10}$ and $PM_{2.5}$ concentrations measured during 2010 were substituted with *maximum* concentrations measured during the 2007 to 2011 period (but excluding the atypical peak concentrations recorded during the 2009 regional dust storm event). Although inter-annual maximums were concluded to increase baseline concentrations (e.g. annual $PM_{10}$ concentration levels were 3 µg/m³ to 6 µg/m³ higher; annual $PM_{2.5}$ concentration levels were 1 µg/m³ to 2 µg/m³ higher), the substitution of such maximums within the cumulative assessment did not result in any exceedances of the OEH or NEPM criteria/standards for annual averages.

The significance of using alternative years for the cumulative assessment in terms of compliance with 24-hour average air quality criteria requires modelling of each individual year to enable time-resolved analysis of concurrent peaks. Significance may however be qualitatively assessed by comparing the range in highest 24-hour concentrations and number of air quality criteria exceedance days recorded across years.

The 24-hour average $PM_{10}$ OEH criteria of 50 µg/m³ is infrequently exceeded in the region (0 to 5 days/year) (**Table 1**), generally due to regional events such as dust storms or bushfires

(EPA, 2012). To determine compliance in accordance with the OEH 2005 *Approved Method for Modelling*, any developments in the region would therefore need to be assessed on the basis of whether they are likely to result in additional exceedances. Even a small increment in airborne concentrations due to a proposed development may result in additional exceedances on days when baseline measurements are only marginally below 50µg/m³. Thus, although no additional exceedances were predicted for the T4 Project during the air quality assessment, it is not inconceivable that the use of another year (and even a year with lower maximum 24-hour and annual averages) may result in an additional exceedance. The air quality assessment found that the T4 Project's contribution on the baseline exceedance day assessed is less than 1.3 µg/m³ which is small compared to the criterion of 50 µg/m³.

Given the non-threshold nature of fine particles (i.e. absence of a safe level) the potential for health effects is a function of magnitude of the change in concentrations. The maximum incremental concentrations predicted due to the T4 Project were documented in the AQIA Report to allow regulators to consider the relative risks related to the project (Refer to **Section 8**).

**Table 1. No. of Days with $PM_{10}$ Concentrations above the OEH Level (OEH, 2012b)**

| Type of Station | Station Name (method) | No. Days with $PM_{10}$ Concentrations above the OEH Level of 50µg/m³ | | | | |
|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009(a) | 2010 | 2011 |
| Continuous Stations | Newcastle (TEOM) | 3 | 2 | 13 | 1 | 0 |
| | Wallsend (TEOM) | 2 | 1 | 10 | 0 | 0 |
| | Beresfield (TEOM) | 5 | 5 | 15 | 0 | 0 |
| 1-in-6 day Stations | Steel River Estate (HVAS) | 2 | 0 | 0 | 0 | 0 |
| | Mayfield (HVAS) | 1 | 1 | 0 | 0 | ND |
| | Stockton (HVAS) | 0 | 0 | 0 | 0 | ND |
| | Fern Bay (HVAS) | 2 | 1 | 0 | 0 | 0 |
| | Fullerton Rd Stockton (HVAS) | 0 | 0 | 0 | 0 | 1 |

ND – no data referenced within OEH, 2012b; HVAS – high volume air samper; TEOM – tapered elemental oscillating microbalance

(a) Dust storms in 2009 resulted in significantly elevated particle concentrations (OEH, 2012b).

### 4.7.2 Adequacy of Existing Air Quality Monitoring and Future Monitoring

- Existing air quality monitoring is inadequate. Points raised include:
  - There is no continuous $PM_{2.5}$ or $PM_{10}$ monitoring at Stockton.
  - Several air quality monitoring stations measure particulate matter only once in six days, thus potentially missing high pollution days.
  - There is limited $PM_{10}$ characterisation.
  - There is no $PM_1$ and $PM_{0.1}$ monitoring conducted in the region.
- The City of Newcastle submission specifies that the Lower Hunter Air Quality Monitoring Network should be prioritised and the proponent should engage with OEH to enable the proposed network to be implemented.
- Will passive dust collectors be used to test effectiveness of any topical treatments?

Air quality monitoring data from a number of monitoring stations were referenced in the air quality assessment, including 7 x TSP stations, 9 x $PM_{10}$ stations, 23 x dust deposition gauge sites, 3 x $PM_{2.5}$ stations, 2 x $SO_2$ and NOx monitoring sites and 1 x BTEX monitoring station. In some cases data were not available in the public domain but was accessed following permission requests or data purchases. Reference was made to long term monitoring data sets where available.

Gaps in 1-in-6 day HVAS monitoring data sets were supplemented with monitoring data from nearby continuous monitoring stations to increase data completeness. By example, $PM_{10}$ sampling data at Fern Bay and Stockton were supplemented by measurements from the HDC continuous monitoring station at Mayfield. A data completeness of 92% was achieved in this manner for the baseline year included in the cumulative modelling.

Fine particles have a longer atmospheric residence time compared to coarser particles, and as a result $PM_{2.5}$ concentrations vary less significantly spatially compared to $PM_{10}$. $PM_{2.5}$ monitoring is conducted at three stations in the region, namely the OEH Wallsend and Beresfield continuous monitoring stations and the ANSTO Mayfield 1-in-six day sampling station. Specific reference was made to the $PM_{2.5}$ concentration measurements and results from $PM_{2.5}$ characterisation at the ANSTO Mayfield site due to its relative proximity to the T4 Project site. To provide the data completeness needed for the quantitative baseline characterisation for cumulative assessment purposes, data was drawn from the continuous $PM_{2.5}$ monitoring data set from the OEH Wallsend station.

Overall the use of all available air quality monitoring data sets allowed for a reasonable characterisation of baseline air quality for air quality assessment purposes. Following its review of air quality monitoring data from its own monitoring network and industrial sites, OEH (2012a, 2012c) similarly concluded that the regional air quality monitoring for the Lower Hunter region is adequately described by the current Newcastle, Wallsend and Beresfield monitoring sites. Furthermore that Newcastle and the ports are fairly well covered by industry monitoring sites.

Despite the number of existing monitoring sites, there is merit in additional air quality monitoring in the vicinity of the port, and particularly continuous ambient $PM_{10}$ and $PM_{2.5}$ monitoring. Robust continuous neighbouring monitoring in line with Australian Standards, and timely access to monitoring information by regulators, the community and industry will support air quality management. Such monitoring will enable tracking of air quality impacts associated with port expansion. The OEH is proposing to establish a Lower Hunter Air Quality Monitoring Network. Real time monitoring of $PM_{10}$ and $PM_{2.5}$ concentrations for compliance assessment purposes is expected to be addressed in establishing this network, with attention paid to cumulative concentrations in the siting of stations. PWCS has indicated support for the development of a Lower Hunter Air Quality Monitoring scheme, facilitated through EPA.

$PM_1$ and $PM_{0.1}$ concentrations are not currently measured on an on-going basis by regulators within Australia, nor are ambient air quality standards published for these particle size fractions within NSW, inter-state, nationally or internationally. Monitoring of fine and ultra-fine particle concentrations are primarily conducted on an experimental basis for research purposes. By example, the Special Additional Pollution Measures (SAPM) Study initiated last year aims to measure $PM_1$ (in addition to $PM_{2.5}$ and $PM_{10}$) concentrations at a range of sites across the Upper Hunter for future population exposure assessments. This study also aims to test the hypothesis that spatial variation in fine particle pollution ($PM_{2.5}$ and $PM_1$) across the Upper Hunter Valley is small enough that exposure can be well characterised by measurement at 3 monitoring sites (Singleton, Muswellbrook and Camberwell). The findings of this study will inform fine particle monitoring elsewhere in the state including the Lower Hunter.

It is not certain what is meant by the question of whether passive dust collectors be used to test effectiveness of any topical treatments. It is however noted that the PWCS air quality monitoring network includes passive dust deposition gauge monitors, with the coal fraction of deposition dust analysed.

### 4.7.3 Accounting for Approved Developments

Specific issues raised about the manner in which approved developments were considered in the baseline characterisation:

- Emission estimates taken from environmental assessments for approved future developments may underestimate actual emissions when the sites are operational.
- Have all existing and proposed industrial developments been accounted for.

To account for potential post-2010 increments in air pollutant concentrations and deposition rates due to future developments, source data and emissions estimates for anticipated future developments were drawn from previous air quality assessments conducted for such developments as part of the environmental assessment and approvals process (GHD, 2003; Holmes Air Sciences, 2006, 2007; ENSR AECOM, 2009, 2010, 2011a, 2011b; PAEHolmes, 2009; URS, 2009, 2012; ERM, 2011). This included all approved industrial developments on and near Kooragang Island, as well as some proposed developments that are not yet approved. Incremental air pollutant concentrations due to the anticipated future developments were modelled and paired with 2010 air quality monitoring data to project “future baseline air quality” for use in the cumulative assessment for the T4 Project (Refer to **Section 5**, **Section 8** and **Appendix C** within the AQIA Report).

The approach adopted by ENVIRON assumes that the accuracy of emission estimates and source configurations within the original assessments are within acceptable bounds given that these assessments met the adequacy requirements of regulators during the respective EA processes. Furthermore, OEH usually requires Environmental Protection Licence holders to undertake additional analysis during the operational phase to demonstrate that the air quality effect of their operations are within the levels previously predicted.

Air quality impacts due to existing industrial developments are accounted for within the baseline air quality monitoring data. Approved developments were identified through the review of the DP&I major developments website, and subsequent consultation with DP&I and OEH to determine whether any significant approved developments were omitted.

Since the AQIA was completed in February 2012 some additional developments have been approved. Furthermore, the DP&I requested that selected *proposed* projects be considered in the cumulative assessment of the Modified T4 Project. The projections for baseline air quality were revised to account for such additional developments and proposed projects in conducting the air quality assessment for the Modified T4 Project (ENVIRON, 2013).

### 4.7.4 Existing Air Quality and Related Health Effects in the Region

The view was held in a number of the submissions that existing air quality in the region is very poor and is currently resulting in health and amenity impacts. Statements made to this effect include the following:

- The Hunter region already has a disproportionate share of NSW's air pollution, particularly $PM_{10}$ and $SO_2$.
- The WHO annual average $PM_{10}$ guideline (20µg/m$^3$) is exceeded at most long term monitoring sites near the river, which is injurious to health.
- Hunter has the worst air quality in Australia.
- Newcastle's existing poor air quality is likely to be impacting human health; its effects are not understood.

Several submissions cite existing dust impacts and prevalence of air quality related health effects in suburbs close to Kooragang. Reference is made in submissions to visible coal dust impacts, high levels of asthma and other respiratory ailments directly linked to exposure to coal dust and emissions.

**AQIA Findings**

Existing air quality was taken into account in the cumulative modelling and assessment. The baseline air quality characterisation study focused primarily on describing the existing air quality within the region, rather than comparing local air quality relative to other areas. Based on the analysis of the available monitoring data (Refer to Section 5 in the AQIA Report), conclusions drawn were as follows:

- $NO_2$, $SO_2$ and CO concentrations are below OEH air quality impact assessment criteria.
- TSP concentrations and dust deposition rates are generally below OEH air quality impact assessment criteria, with criteria exceedances restricted to within the industrial area on Kooragang Island.
- Baseline annual average $PM_{10}$ concentrations are below the OEH criterion (30µg/m$^3$).
- There are infrequent exceedances of the OEH criteria for 24-hour $PM_{10}$ concentrations (50 µg/m$^3$) in the region. Daily average $PM_{10}$ concentrations are recorded to typically range between 12 and 24 µg/m$^3$ with elevated concentrations of 30 to 40 µg/m$^3$ occurring about 5% of the time, and infrequent peaks in the range of 50 to 80 µg/m$^3$.
- Baseline annual average $PM_{2.5}$ concentrations are generally below the NEPM advisory reporting standard (8µg/m$^3$), with infrequent exceedances of the 24-hour reporting standard primarily coinciding with regional events such as bush fires or dust storms (ANSTO, 2008; OEH, 2012b).
- Coal particles comprise 5% to 16% of the annual dust deposition recorded by the Kooragang Coal Terminal (KCT) dust deposition gauge network over the 2005 to 2010 period. Based on grab sample studies, coal particles are generally found to comprise less than 10% of dust deposition at Tighes Hill, Fern Bay and Stockton.
- Based on the $PM_{2.5}$ characterisation work undertaken by ANSTO (2010), combustion-related sources, secondary particles (sulphate) and sea salt were determined to

contribute significantly to fine particle concentrations; contributing over 90% of the $PM_{2.5}$ mass recorded in Mayfield during the 1998 to 2009 period.

OEH reports for NSW regional air quality performance within annual NEPM reports (http://www.ephc.gov.au/nepms/air/air_nepm.html), indicate that higher $PM_{10}$ concentrations are experienced in some years (e.g. 2009) due to extended drought conditions and a high occurrence of dust storms and bushfire events. Elevated concentrations recorded concurrently across many spatially-distant regional monitoring stations in NSW, and satellite imagery of regional pollution plumes, indicate that these natural events significantly influence $PM_{10}$ levels regionally.

The characterisation of air quality with reference to NSW and national air quality criteria is widely applied and is in accordance with the OEH *Approved Methods for Modelling*. Due to the non-threshold nature of several air pollutants, including fine particles, the management of such pollutants is driven by best management practice (BMP) principles as outlined by the POEO Act (Chapter 1, Section 3). The AQIA thus included a BMP review of the control measures proposed for implementation by the T4 Project.

**Comparison of NSW Criteria and WHO Guidelines for Particles**

The significance of measured particle concentrations were primarily evaluated in the AQIA with reference to OEH air quality impact assessment criteria (TSP, $PM_{10}$) and NEPM advisory reporting standards ($PM_{2.5}$). Given the reference made in several of the submissions to WHO guidelines, further information is provided on the application of WHO guidelines and how they compare to local air quality criteria.

Given the non-threshold nature of fine particles, all thresholds selected as the basis for air quality guidelines or standards are risk-based. The World Health Organisation (WHO) notes that, when setting standards, countries must balance the acceptability of risk factors and the need to protect vulnerable population groups against issues of feasibility and the anticipated costs of compliance (WHO, 2006). To support air quality management by jurisdictions, the WHO publishes ranges of interim targets for $PM_{10}$ and $PM_{2.5}$ (WHO, 2005). In some cases WHO guidelines are more stringent than those applied in NSW, and in other cases they are expressed in a less stringent manner.

Overall the WHO guidelines for $PM_{2.5}$ are less stringently expressed compared to the NEPM advisory reporting standard. The WHO annual average $PM_{2.5}$ guideline (10 µg/m³) is marginally higher than the NEPM annual average advisory reporting standard (8 µg/m³). Furthermore, the WHO publishes interim guidelines for annual average $PM_{2.5}$ in the range of 15 µg/m³ to 35 µg/m³ to support progressive air quality improvement by countries (WHO, 2005). The WHO 24-hour guideline for $PM_{2.5}$ is equivalent to the NEPM $PM_{2.5}$ advisory reporting standard in terms of the concentration level referenced (25 µg/m³), but is expressed as the 99$^{th}$ percentile 24-hour average (i.e. the 4$^{th}$ highest value of the year) and is therefore less stringent that the NEPM advisory reporting standard.

Similarly the WHO 24-hour guideline for $PM_{10}$ is equivalent to the OEH $PM_{10}$ criterion in terms of the concentration level referenced (50 µg/m³), however the WHO guideline makes reference to the 99$^{th}$ percentile 24-hour average (i.e. the 4$^{th}$ highest value of the year) not the 100$^{th}$ percentile or highest value as per the OEH criterion. The WHO guideline for annual average $PM_{10}$ is given as 20 µg/m³, with interim targets for annual average $PM_{10}$ being in the range of 30 µg/m³ to 70 µg/m³ to support progressive air quality improvements by countries. The OEH annual $PM_{10}$ criterion (30 µg/m³) is equivalent to WHO interim target 3.

**OEH Findings on Existing Air Quality in Newcastle**

The overall conclusions on baseline air quality within the AQIA Report are supported by the recently completed OEH studies (2012a, 2012b, 2012c). Based on the assessment of available information, OEH (2012c, p. I) concludes that:

- *"Regional air quality in the Lower Hunter is adequately described by the current OEH monitoring sites at Newcastle, Wallsend and Beresfield and, with the exception of extreme events (bushfires and dust storms), generally meets national ambient air quality standards and goals.*
- *Industry ambient air quality monitoring around the port precinct is comprehensive but has a different purpose to OEH's regional network; it is premises-specific and focussed primarily on particles, with some $NO_2$ and $SO_2$ monitoring.*
- *These industry monitoring data show that while industrial emissions contribute to occasional high concentrations of particles (as TSP and $PM_{10}$) and nitrogen dioxide, air quality in the port is generally good.*
- *While nothing in these reports points to a broad scale air quality problem due to industrial emissions around the port, the potential impact on air quality in surrounding suburbs of the proposed future industrial expansion in the port provides an opportunity to review the effectiveness of the current monitoring arrangements around the port.*
- *Community input should be sought during any review process to ensure transparency and community acceptance of any proposed changes to monitoring in the port precinct."*

In addition to undertaking an analysis of air quality monitoring data from the Lower Hunter, the OEH compared levels to Sydney and the Illawarra. Following a comparison of regional air quality, the OEH (2012c, p. 2) concluded that "overall air quality in the Lower Hunter is as good – or better than – air quality in Sydney and the Illawarra". OEH recognises that whereas their assessment does not indicate any current air quality problem in the port precinct, the general community has concerns regarding the impact of local industrial emissions on their community (OEH, 2012c, p. 4). OEH notes that making industry data publicly available may allay these concerns.

**Existing Health Impacts**

Profiling the health status of the local population was not required by the Director General's EARs, and was not included in the scope of the Environmental Assessment. Such profiling is generally undertaken as part of Health Impact Assessments. Further considerations in respect of health impact assessments are however provided in **Section 4.12** of this response.

## 4.8 Emissions Inventory and Modelling Method

Issues and questions raised in regard to the manner in which emission were estimated and the dispersion of such emission modelled are as follows:

- Use of 2010 meteorological data is not representative of future meteorology, as it does not take into account the impact of climate change on weather patterns.
- Project emission estimates are underestimated:
  - 'World best practice' dust controls are assumed.
  - In practice breaches of controls could occur resulting in higher emissions.
  - Emission factors for new or near new engines are assumed in quantifying diesel exhaust emissions from construction equipment.
- Particle size distribution data appear not to be presented for coal, road and construction dust emitted. Does the assumed particle size exhibit a log normal distribution?
- Advice sought be sought from OEH on whether appropriate uncertainty estimates have been built into predicted particulate impacts.

### 4.8.1 Meteorology for Dispersion Modelling

**Representation of Prevailing Meteorology based on 2010 Meteorological Records**

The approach conducted in selecting an appropriate year of meteorological data was in accordance with the requirements of OEH, as specified within the *Approved Methods for the Modelling*. The use of the 2010 period meteorological dataset was justified on the basis of the comparison of 2010 data with historical records; specifically wind field, rainfall and temperature records. The 2010 year was characterised by below average rainfall (**Figure 1**), and representative airflow patterns (**Appendix A**), wind speed ranges (**Figure 2**) and ambient air temperatures (**Figure 3**) based on comparison with longer term records.

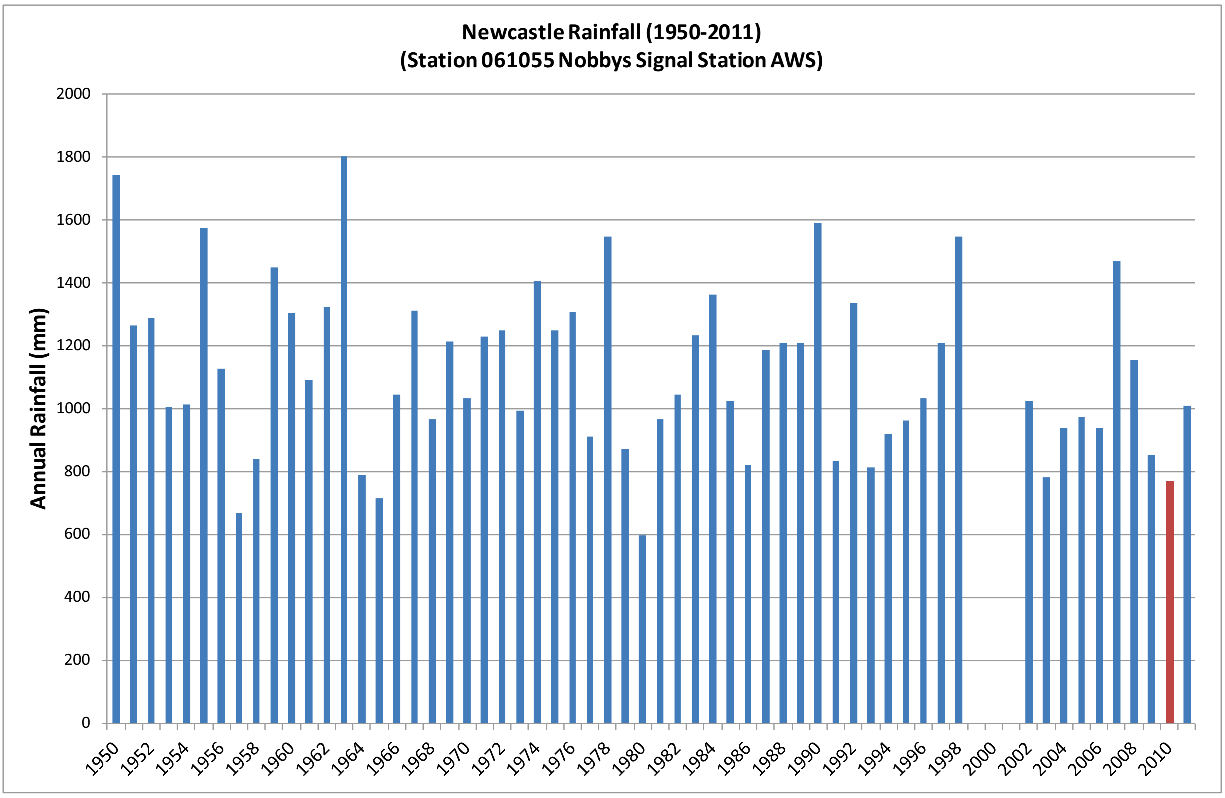


**Figure 1: Nobbys Signal Station – Annual rainfall (1950 – 2011)**

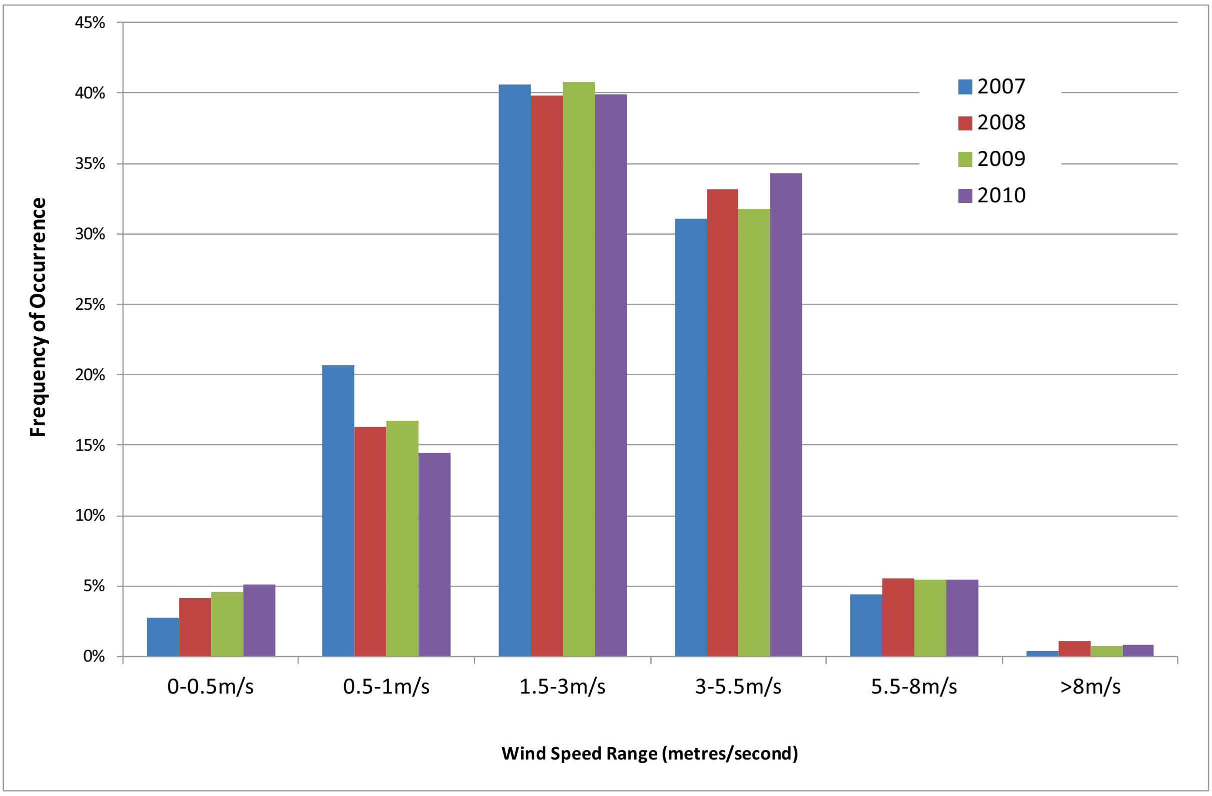


**Figure 2: KCT Monitoring Station – Comparison of wind speed ranges (2007–2010)**

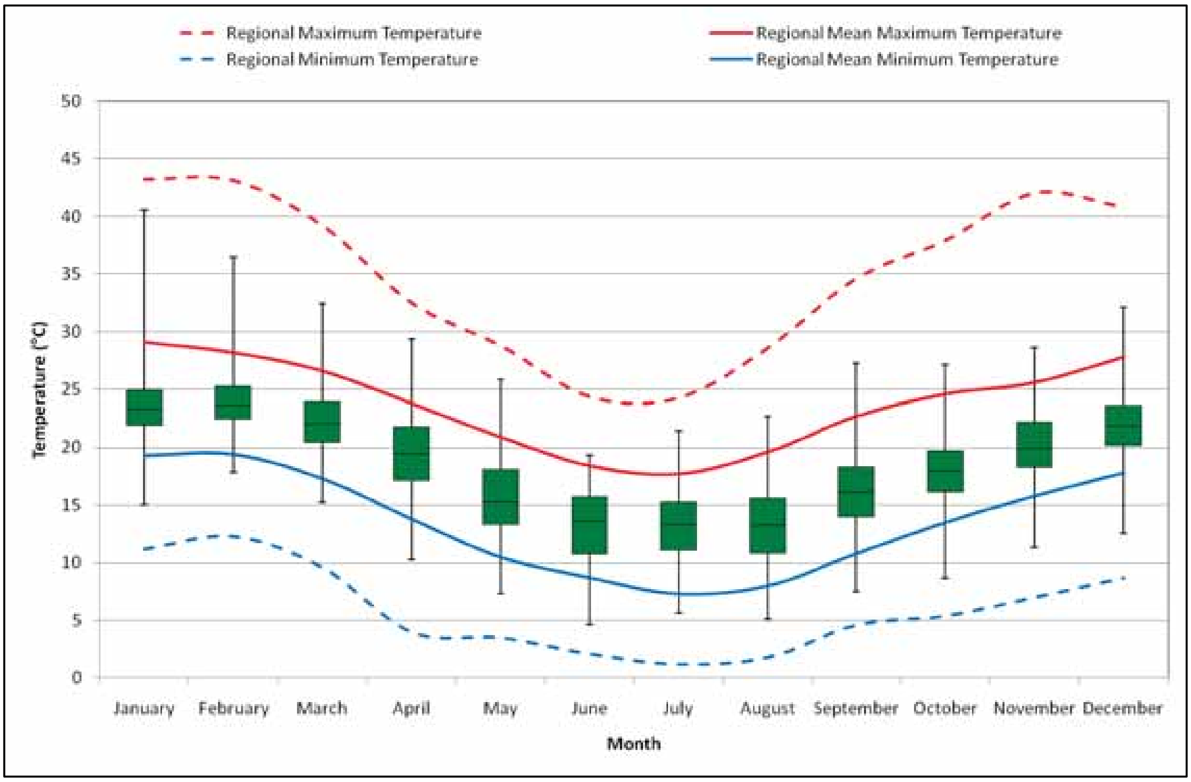


**Figure 3: Temperature Comparison between Kooragang Island (2010) and Bureau of Meteorology Williamtown RAAF Station (1942-2011)**

Note: CALPUFF-predicted temperatures are illustrated by the green 'box and whisker' indicators. Boxes indicate 25th, Median and 75th percentile temperature predictions while upper and lower whiskers indicate maximum and minimum values. Measured maximum and minimum temperatures are depicted as line graphs.

The use of a more current year is supported by historical trends in ambient temperature and rainfall, as discussed further below.

**Long Term Trends in Climate and Impact of Climate Change on Local Meteorology**

Potential changes to local meteorology due to climate change were considered to address issues raised in this regard. Reference was made to the climate projection report entitled *Hunter, Central Coast and Lower North Coast: Regional Climate Change Project 2009* completed by the University of Newcastle and Macquarie University for the Hunter and Central Coast Regional Environmental Management Strategy, a program of the Environment Division of Hunter Councils. Specific attention was paid to historical trends in climate and projected changes in climate for the Newcastle City Council Local Government Area (LGA)[(1)].

Historically, the Newcastle LGA has experience a statistically significant decrease in annual rainfall of 274 mm in the coastal zone over the period 1948 to 2007, and a statistically significant annual increase in average maximum temperatures of 0.9°C in the coastal zone. There has been no change in annual average wind speed in the coastal zone over the past four decades.

[1] http://www.newcastle.nsw.gov.au/__data/assets/pdf_file/0019/122392/Climate_Profile_-_Newcastle_City_Council_Local_Government_Area.pdf

Climate projections for the period 2020 to 2080 for the coastal zone of the Newcastle City Council LGA, of relevant to the T4 Project, are summarised as follows:

| **Season** | **Temperature** | | **Rainfall(a)** | **Wind Speed** |
|---|---|---|---|---|
| | **Mean Maximum** | **Mean Minimum** | | |
| Summer | -0.2°C | -0.9°C | No significant change | -0.1km/hr |
| Autumn | +1.1°C | +1.4°C | No significant change | +1.5km/hr |
| Winter | +1.3°C | +1.3°C | Drier (13% decrease) | -0.2km/hr |
| Spring | -0.7°C | -0.2°C | Wetter (15% increase) | -1.4km/hr |

(a) Projected changes relative to the generally wetter 1948-1977 period which was characterised by a La Nina'-phase in the Inter-decadal Pacific Oscillation

Average annual rainfall patterns are projected to stay within the boundaries of existing known natural variability. However, it is projected that rainfall patterns will return to the generally wetter and more variable conditions experienced during the 1948-1977 period, which are associated with 'La Nina'-phases in the Inter-decadal Pacific Oscillation.

Average maximum temperatures are projected to increase during autumn and winter, and decrease in spring and summer.

Projected average changes in rainfall, temperature and wind speed do not indicate any significant changes in local meteorology. It is however important to consider the potential for increases in extreme events. The frequency of weather patterns responsible for extreme storm events along the NSW coast are projected to be likely to increase, indicating a higher probability of high wind and associated extreme rainfall events. Of greater significance to air quality is likely to be the projected increase in the frequency of extreme heat days. Projected to occur during summer and autumn, an increase in the frequency of extreme heat days may increase regional dust storm and bush fire risks potentially giving rise to more frequent fine particle guideline exceedances. Wind erosion potentials will also be higher for the T4 Project for extreme heat days. The use of predictive/reactive monitoring to inform contingency measure implementation, as committed to by PWCS for the T4 Project, will address such risks. PWCS has also committed to investigating coal moisture management based on dust extinction moisture levels and 'optimum moisture levels', which if adopted, would also address these risks.

The exact implications of projected climate changes for the T4 Project are not explicitly clear due to the inherent uncertainty in climate modelling and the wide window (60 years) for which projections are undertaken. There is no robust, time-resolved meteorological data set incorporating likely climate changes for the period covering the life of the T4 Project to adequately model the effect of climate change. Consequently, it is considered that the implementation of effective predictive and reactive management systems including contingency measures, as detailed in PWCS's statement of commitments in **Section 15.7** of the RTS/PPR main report, will provide the most effective means of accounting for possible increases in the frequency of extreme climate events.

### 4.8.2 Emission Estimates and Control Efficiencies

Given the no-threshold nature of fine particles, and considering that the 24-hour $PM_{10}$ criterion is infrequently exceeded given existing air quality, the degree to which the T4

Project implements best management practices was reviewed during the AQIA. Practices committed to by the project proponent were taken into account in the modelling, with other practices recommended for implementation but not assumed to be implemented.

Reference was made to the literature in deriving dust control efficiencies associated with specific control measures. Whilst assuming that efficient wet suppression spray systems will be implemented in the stockyard, a lower bound dust control effectiveness (50%) was assumed in the emission quantification to provide an upper bound (conservative) estimate of emissions. In cases where the effectiveness of dust control measures could not be quantified, 0% control efficiency was assumed.

According to a recent study into dust control efficiencies achieved through watering at KCT, Kruse (2012) projected coal stockpile control efficiencies for a range of water application rates. KCT's current water application rate is given as being in the range of 0.5 to 0.7 litres/m² (*personal communication*, Nick Godfrey-Smith, PWCS, December 2012). According to Kruse (2012) a water application rate of 0.6 litres/m² results in a dust control efficiency of 67% at KCT. The adoption of a 50% dust control efficiency for wind blown emissions from T4 Project coal stockpile areas is therefore considered to be an upper bound (conservative) estimate of emissions.

Upset emissions occurring due to breaches in dust controls were not modelled in the AQIA. Instead the implementation of a predictive and reactive management system is proposed to identify breaches and inform actions, as detailed in the statement of commitments in **Section 15.7** of the RTS/PPR main report.

To quantify diesel-exhaust emissions from construction plant reference was made to emission factors, load factors and power ratings drawn from ENVIRON (2009). These emission factors are based on the emission factors within the US-EPA NON-ROAD MOBILE 2008 model but reflect emission standard compliance profiles typical of construction plant sold into the Australian market in 2008.

### 4.8.3 Particle Size Data

The particle size distribution of wind erosion and materials handling emissions for the T4 Project were quantified based primarily on US-EPA AP42 emission factors. The application of these emission factors resulted in $PM_{10}$ emissions being derived to be 47% of TSP for coal handling and 50% of TSP for wind erosion; with $PM_{2.5}$ emissions estimated to comprise 15% of $PM_{10}$ emissions.

Based on particle size distribution measurements conducted downwind of coal handling operations in the Hunter Valley, the $PM_{10}$ fraction of TSP was measured to be on average about 40%, with about 10% of the $PM_{10}$ being in the $PM_{2.5}$ range (SPCC, 1986). The application of US-EPA AP42 emission factors may therefore have provided a more conservative (upper bound) estimate of fine particle emissions.

TSP, $PM_{10}$ and $PM_{2.5}$ were represented within CALPUFF as having a nominal mean particle size of 11, 4 and 0.48 micrometres respectively. A geometric standard deviation of 2 was applied which assumes an even distribution for each particle size fraction.

### 4.8.4 Accounting for Uncertainty

In response to the submission suggesting that advice sought be sought from OEH on whether appropriate uncertainty estimates have been built into predicted particulate impacts, the following response is provided.

The air quality assessment was undertaken in accordance with the OEH (2005) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* In compiling the emissions inventory and undertaking the dispersion modelling conservative assumptions were frequently applied to provide an upper bound estimate of air quality impacts. By example, construction activities were assumed to occur simultaneously with activities positioned within parts of the project area which were closest to off-site receivers. Furthermore, emission reductions due to agreed control measures where not taken into account unless the dust control effectiveness of such measures were published within widely referenced literature.

The air quality assessment underwent an adequacy review, which included review by the OEH, prior to being finalised for inclusion within the EIS.

## 4.9 Impact Assessment Approach

Concerns regarding the approach adopted to assess the acceptability of projected changes in air quality related to the T4 Project are raised in a number of submissions, as follows:

- Modelling shows there will be increased small particle exceedances, which is not acceptable to the community and non-compliant with air quality requirements.
- Air quality guidelines are exceeded on an average of 1-2 days per year. T4 will exacerbate this.
- The EA seeks to demonstrate there is no increase in the number of exceedances of the 24 hour average $PM_{10}$ concentration, but this may be of questionable relevance where there are exceedances at baseline and the project exacerbates the exceedances.
- While EA states that there will only be minimal increase this should be measured against the public expectation that particulate levels should be being reduced in the inner city of Newcastle.
- Until assessment guidelines for impacts on human health from dust generated by mining and other activities are finalised in December 2012, the NSW Government does not have the information required to approve this proposal or understand the potential impacts of the required expansion of coal mines to supply a fourth coal export terminal.
- NEPM tolerance of five exceedances per year is not considered appropriate in the DEC (2005) Approved Methods.

In assessing air quality monitoring data from OEH monitoring stations it is appropriate to make reference to OEH and NEPM air quality criteria. This is routinely done by the OEH/EPA when reporting air quality levels recorded. Air quality impacts due to the T4 project were assessed based on the OEH air quality criteria as detailed further in subsequent paragraphs.

As discussed in **Section 3** and **Section 8** of the AQIA Report, the *Approved Methods for Modelling* provides the following guidance for dealing with elevated background concentrations when assessing cumulative impacts associated with proposed developments (OEH, 2005, p. 20):

> *In some locations, existing ambient air pollutant concentrations may exceed the impact assessment criteria from time to time. In such circumstances, a licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.*

In accordance with the *Approved Methods for Modelling*, the likelihood of further exceedances of the impact assessment criterion occurring due to the T4 Project was evaluated, and the dust management practices proposed for implementation reviewed. Further discussion on the control measure review is provided in the subsequent section.

Based on the time-resolved, detailed cumulative air quality modelling conducted for 2010 no additional exceedances were predicted to occur due to the T4 Project with planned dust controls implemented. It is however not inconceivable that the use of another year (and even a year with generally lower concentrations) may resulted in an additional exceedance(s) as discussed in **Section 4.7.1**. Given the non-threshold nature of fine particles, the potential for health effects is a function of magnitude of the change in concentrations. The maximum incremental concentrations predicted due to the T4 Project were documented in the AQIA Report and the updated assessment in Appendix O of the RTS/PPR to allow regulators to consider the relative risks related to the project.

The Hunter New England Local Health District submission notes that the projected minimal increase in $PM_{10}$ due to the T4 Project needs to be balanced against both a community and public health expectation that particulate levels should be reduced in inner city Newcastle, not increased. Even with best practice controls implemented, the T4 Project will result in additional dust emissions. Addressing existing airborne particulate concentrations necessitates the realisation of emission reductions from existing sources. Consideration of emission reduction options for existing sources was not within the scope of the T4 Project AQIA.

Reference is made to assessment guidelines for impacts on human health from dust generated by mining and other activities to be finalised in December 2012. ENVIRON is not aware of any proposed alternative air quality guidelines for application within NSW (as at January 2013).

## 4.10 Dust Control Measures

Issues raised in submissions in respect of emission control measures are as follows:

- If approved, coal stockpiles should be surrounded by wind fences or put in buildings, as occurs overseas. This should be applied at T4 and existing coal stockpiles on Kooragang Island.
- If approved, all coal stockpiles should be simultaneously sprayed, rather than one after another as currently occurs. This applies during strong winds, including any westerly winds.
- Coal should be deposited directly onto ships to avoid emissions from stockpiling and recovery.

- Water spraying alone is not enough to manage dust nuisance; need to consider additional measures.
- Dust suppression is critical, wind fences and spraying/treating coal with chemical agglomerate should be applied.
- Does not address how these will be monitored and managed or explain PWCS's responsibility to clean up wagon spills and leaks.
- Coal wagons should be covered.
- Particle control measures in Chapter 9 of the AQIA must be implemented.
- What are the consequences if T4's operation regularly results in higher than predicted levels of particle pollution?
- Recommend additional mitigation measures for weather conditions where the NEPM goal is likely to be exceeded (NSW EPA submission, G441).

In assessing best management practice measures applicable to the T4 Project, attention was paid to measures applicable to the largest project-related $PM_{10}$ emission sources which are under the operational control of PWCS. Best practice measures were evaluated during the AQIA based on a detailed review of the literature and taking into account measures being implemented by coal terminals locally and internationally. Attention was paid to technically and economically viable (or potentially viable) measures. This approach is consistent with local and international definitions of best practice, e.g. the EU's definition of Best Available Techniques (BAT), the US definition of Best Demonstrated Technologies (BDT), Western Australia's definition of 'Best Practicable Measures' (BPM) and the approach adopted by the Victorian government (EPA Victoria, 2007; WA DEC, 2003; EC, 2009; US Regulation 40 CFR Part 60).

Based on a review of documented practices at port and related operations[(2)], additional controls identified as being potentially practicable were recommended for investigation by PWCS to determine suitability for the T4 Project. Following a review of the practicability of measures PWCS confirmed that the following measures will be implemented to control emissions from the T4 Project's operations:

- Dump stations will be partially enclosed (roof and side walls with openings only for train ingress/egress);
- Dust suppression sprays will be provided;
- Bottom dumping of coal will be undertaken;
- Belt conveyors will be partially enclosed where practical (ie excluding yard and ship conveyors);
- 'Soft' flow hood and spoon-type chutes will be provided on transfers which reduces coal degradation potential;

[2] US-EPA RACT/BACT/LAER Clearinghouse (accessed October 2011), Katestone Environmental (2010), Planner (2010), NIOSH (2010), Queensland Rail Network (2010), European Commission (2006), AS 4156.6-2000, Connell Hatch (2008), DBCT (2007), Asia-Pacific Partnership on Clean Development and Climate – Coal Mining Task Force (2009).

- A belt cleaning system will be provided on all conveyors;
- Water sprays on coal in transit will be provided where appropriate;
- Transfer houses will be clad;
- Dust suppression (water) sprays will be provided on stockpiles;
- Wind guards will be installed on yard and ship conveyors where appropriate;
- Vehicle movements will be minimised within the stockpile area;
- Earthen bund walls and/or tree screening will be used, to minimise wind velocities on-site or to remove dust through impaction, where appropriate;
- Variable height stackers will be provided, so that drop heights can be minimised;
- Dust suppression will be included on stackers and reclaimers;
- The discharge chute at the end of the boom conveyor on shiploaders will be enclosed;
- Shiploader spouts will be extendable to allow loading to occur low in vessel holds;
- Dust suppression sprays will be provided on shiploaders;
- There will be provision for a launder system on the shiploader conveyor to return spillages;
- The buffer bins near the shiploaders will be enclosed as appropriate;
- Progressive sealing of permanent internal access roads will be undertaken;
- Any coal spillages will be cleaned up in a timely manner;
- Landscaping of open areas will be undertaken, where practical;
- A reactive/predictive air quality control system will be applied. It will be a real-time management system that uses continuous particulate matter and meteorological monitoring data, and meteorological forecast data, to identify triggers for contingency dust management measures, such as additional use of water sprays. This system may be fully automated, incorporating trigger alarms, automated reports and SMS and email alarms to prompt contingency measures;
- PWCS employees will be trained to ensure dust minimisation is prioritised and visual triggers and arising actions are effectively implemented; and
- PWCS will continue to work with ARTC and coal producers around reducing fugitive dust emissions from trains.

The use of the reactive/predictive air quality control system it intended to optimise the use of water sprays, allowing coal stockpiles to be sprayed ahead of strong wind periods as a preventative measure. This will be more beneficial that simultaneous spraying of stockpiles following the onset of strong winds.

A number of the dust control measures committed to by PWCS are considered best practice measures. Furthermore, PWCS has committed to the investigation of the following measures to determine their suitability for the T4 Project:

- Coal moisture management based on Dust Extinction Moisture (DEM) levels and ‘Optimum Moisture Levels’; and

- The effectiveness of wind barriers.

Dust control measures raised within submissions which were not considered practicable for implementation, or which were outside of the operational control of PWCS, are discussed in subsequent subsections. It should be noted that the air quality modelling and assessment, which assumed that these impractical measures were not in place, found that the T4 Project will not significantly affect surrounding air quality. Reference is also made to additional mitigation measures implementable during adverse meteorological conditions or elevated particle concentrations to avoid air quality criteria exceedances.

**Enclosure of Coal Stockpiles within Buildings**

A review was undertaken to identify cases where coal stockpiles have been enclosed at large coal terminals. No specific cases could be identified by ENVIRON, nor were any specific cases mentioned in the submissions received.

A review was undertaken of recent proposed coal terminal operations or proposed coal terminal expansions within Australia and New Zealand (e.g. Lyttelton Port Company Ltd Coal Stockyard Expansion (New Zealand); Dudgeon Point Coal Terminal, Qld; Abbot Point Coal Terminal Expansion, Qld). Enclosure of stockpiles was either not mentioned or was given as not being economically viable due to the extent of the stockpile area.

Enclosure of coal stockpiles within a building is not identified within the following best practice reviews / clearinghouses:

- Asia-Pacific Partnership on Clean Development and Climate - Coal Mining Task Force (2009). Leading Practice Sustainable Development Program for the Mining Industry - Airborne Contaminants, Noise and Vibration Handbook, October 2009.
- Katestone Environmental (2010). NSW Coal Mining Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining, Report compiled on behalf of NSW Department of Environment, Climate Change and Water, December 2010.
- NIOSH (2010). Best Practices for Dust Control in Coal Mining, Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2010-110, Information Circular 9517, 2010 Jan; :1-76.
- US-EPA RACT/BACT/LAER Clearinghouse (RBLC), http://cfpub.epa.gov/RBLC/ (accessed October 2011).
- Planner J. (2010). Coal Dust Control Techniques – Review of Current Practice, ACARP Project C19007, Published 1 May 2010.
- European Commission (2006). Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Emissions from Storage, July 2006.

Connell Hatch (2008) concluded full enclosure of the Barney Point Coal Terminal (Gladstone, Qld) stockyard would not be viable on a cost benefit basis(3).

Research by PWCS found that enclosure of the stockyard (and yard machines) would be cost prohibitive and impractical operationally. A building approximately 750,000 $m^2$ and 60 m (20 storeys) high would be required, which would be about twice as big as the largest warehouse building in the world (the Boeing factory in Washington). Unlike the Boeing factory, a structure for the T4 Project could not have internal support columns, due to interference with yard machine operation and other structures; it is likely a suspended roof would be required. The large foundations and hold down structures would necessitate a loss in stockpile space and terminal capacity or compensatory increase in the stockyard and total site footprint. Such a building would cost an estimated $750M to $1,350 M to construct excluding an additional 15% - 25% for project management and engineering. There would also be significant schedule impacts with engineering, design and construction timeframes all extended.

**Direct Transfer to Ships**

Some submissions specify that there should be no provision for stockpiling and recovery of coal, with direct transfer of coals from the dump station to awaiting ships. According to PWCS, this measure is not feasible for the following reasons:

- Ship loading efficiency – stockpiling coal ahead of shiploading (rather than loading directly from trains) overcomes efficiency issues associated with varying mine load point capacities, upstream breakdowns and delays, and time to prepare shipments. Coal stockpiling allows each ship to load continuously; to load directly from trains would take three to five days per ship.
- Blending requirements – PWCS is required to blend a variety coal types from multiple mines to produce a single cargo of coal with set quality specifications, determined by PWCS's customers and end users. A cargo assembly method is used to prepare each shipload where coal, potentially from several mines, is deposited in a designated stockpile, depending on its specifications, until a load or cargo is complete. The stacking and reclaiming process also ensures coal is blended to an even quality. This process cannot be completed efficiently or consistently when loading directly from trains.
- Risk management – direct rail loading would expose PWCS and the industry to the significant risk of extended delays due to load point, rail network or train breakdowns. The Hunter Valley Coal Chain is a dynamic operating environment. On any day a number of train services are cancelled or diverted for a variety reasons including load point, train and terminal breakdowns. PWCS maintains an operating policy that states that a stockpile or cargo must be completed assembly before commencing loading of a vessel. This policy protects the industry from major shiploading delays due to upstream delays.

[3] Connell Hatch (2008). Barney Point Coal Terminal Dust Benchmarking Study, Gladstone Port Coal Dust Study, 14 July 2008, Report HR02-03, Revision 0.

**Covering of Coal Wagons**

As discussed in **Section 9.4** of the AQIA Report, the mitigation of dust emissions from rail wagons on-route from the respective mines to the T4 project area is not within the direct operational control of PWCS. The management of dust and other air emissions from rail wagons outside of the T4 project area is the responsibility of the ARTC and rail freight operators. As discussed in **Section 4.5** of this report, ARTC recently commissioned a pilot study to quantify the level of fine particulates generated from the rail transport of coal and other freight in the Newcastle area rail corridor to meet Pollution Reduction Program requirements placed on its Environmental Protection Licence by the NSW EPA (ENVIRON, 2012b). The findings of this study will be considered by the EPA in assessing the need for rail coal wagons to be covered. Potential control measures to reduce coal dust lift off from rail wagons include wagon loading improvements and load profiling, wagon covers / partial covers and the application of chemical surfactants.

**Shipping Emissions**

Control options for marine vessels were not raised by submissions. Additional information is however offered in this respect given the issues raised regarding exhaust emissions from the rail corridor.

As for the rail corridor, fuel combustion emissions from marine vessels are not within the operational control of PWCS. OEH has been investigating emissions generated by ships while in port, and has commissioned studies to analyse operations of NSW Greater Metropolitan Region ports, including Newcastle port, and to determine the scope of opportunities to reduce emissions. As a next step, OEH proposes to consult with Roads and Maritime Services and port authorities to discuss potential emission reduction actions for ports that could be implemented (OEH, 2012b).

**Contingency Measures**

In its submission (G441), the EPA states that:

- Particle control measures for both the construction and operation phase of the project that are presented in Chapter 9 of the AQIA must be implemented to ensure the contributions predicted in the EA are achieved.
- Given the community sensitivity to air quality, in particular dust emissions from industry in the Newcastle air shed, the EPA recommends the proponent identify additional mitigation measures that would be employed during weather conditions where the NEPM goal is likely to be exceeded, thus ensuring that any increased impact is minimised.

As indicated in **Section 9.3** of the AQIA Report and the statement of commitments in Chapter 15 of the RTS/PPR main report, PWCS will implement a reactive/predictive air quality control system to inform the need for contingency measures. The likely configuration of this system is described in **Section 9.3.1** of the AQIA Report. The main contingency measure proposed for implementation during adverse meteorological conditions is the intensification of wet suppression measures. According to Kruse (2012) a dust control efficiency of greater than 80% is achievable given coal stockpile water application rates of approximately 3 litres/$m^2$.

Potential additional measures implementable during adverse meteorological conditions or elevated particulate concentration periods to avoid air quality guideline exceedances include coal moisture adjustment (requires coal moisture conditioning system). PWCS has committed to investigating this control measure to determine its suitability for the T4 Project. The investigations will be completed prior to operations.

## 4.11 Mobilisation of Toxic Contaminants during Construction

Concerns were raised in submissions regarding the potential for inhalation exposures to toxic contaminants arising due to the disturbance of existing contaminants during the construction phase.

In its submission the Newcastle City Council calls for a detailed Remedial Action Plan (RAP) to be provided for assessment prior to determination of the application.

The potential for emissions from contaminated material disturbance during the construction phase is addressed in Section 6.2.1 of the EA's AQIA Report and Section 5.2 of the RTS/PPR's air quality assessment of the modified project. It was concluded in the EA that the potential for trace metal/metalloid and odour emissions during T4 Project construction was minor. This was due to the properties of fill to be used and the T4 Project design. The majority of the imported fill will be saturated (dredged) sand with limited potential for dust generation and the design of the completed landform minimises disturbance to in situ contaminated materials. However, the Modified Project will involve the excavation of some localised areas of potentially contaminated material. Given that the proposed stockyard bench levels are approximately 0.5 m lower than assumed in the EA this will include some additional material to that previously assumed, but only over a slightly increased plan area according to Douglas Partners. The Remediation Action Plan (RAP) and the site-specific materials management plan (MMP) to be included in the CEMP will detail management measures for the project's earthworks to minimise the potential for trace metal/metalloid and odour emissions. This will incorporate outcomes of more detailed sampling and contaminant testing in the areas proposed to be excavated. The RAP (pre-detailed design) is provided in Appendix H of the RTS/PPR.

As committed to in Section 15.3 of the RTS/PPR, human health will be protected during operations by preventing access to contaminants by implementation of the proposed contamination remediation and management measures, including capping. Health protection requirements during construction will be included in the CEMP and the site OHS safety plan and may include use of personal protective equipment (PPE) and site-specific procedures in areas where contaminants may exceed the safe threshold values; and use of exclusion zones where appropriate.

## 4.12 Health Impacts due to the T4 Project / Calls for Health Impact Assessment

A number of submissions raised concerns regarding the health impacts associated with the T4 Project, with some submissions calling for a comprehensive health impact assessment to be undertaken for the project. The submissions received included two lengthy submissions, one from 'Newcastle Public Health Professionals' (Submission 461) and one from Doctors for the Environment Australia (Submission 329). Health impact related issues are summarised by topic below.

- Health Effects of Fine Particles
  - Any increased exposure to particulate pollution is associated with increased adverse health outcomes, even if levels are below current guidelines.
  - The air quality standards are inadequate to prevent additional health risks from particulates and combustion gases.
  - Community concerns about health impacts of fine particulate matters not adequately addressed.
  - Raises health effects of particulate matter, particularly fine particles; even levels below OEH guidelines negatively impact health. Evidence that health effects are related to particle surface area and/or number concentration.
- Health Risks due to Coal Dust and Applicability of Air Quality Standards
  - Current air guidelines are outdated and do not account for recent health studies which demonstrate TSP (coal dust) is of greater detriment to human health.
  - Exposure to increased coal dust and carcinogenic fine dust particles emanating from stockpiles.
  - Evidence that carbonaceous particles such as diesel soot (and likely coal dust) have more significant health impacts than other ambient aerosols.
  - Human, livestock and ecosystem health impacts of coal dust (which may be carcinogenic), $PM_{2.5}$, nitrogen oxides, $PM_{10}$ and heavy metals that may be present in coal dust, including effects on quality of life and wellbeing.
  - Release of dust from coal handling at stockpiles, containing small particles of coal; particularly concerned about respirable fraction ($PM_{10}$ and particularly $PM_{2.5}$) - health risk.
  - Concerned that literature cited in the EA did not justify the conclusions. The review of literature was superficial at best and distorted the findings of several studies that were cited (specific examples contained in the full submission – N461).
  - Both current AQ standards and the modelling approach in the EA are inadequate to protect the public's health as they fail to include risk information about short-term exposure events. The burden of disease is proportional to the level of exposure.
- Diesel Particulate Matter
  - Evidence that carbonaceous particles such as diesel soot (and likely coal dust) have more significant health impacts than other ambient aerosols.
- Need for a Health Risk Assessment / Health Impact Assessment

Issues raised regarding health risks associated with air emissions from the T4 Project are addressed in this section. Reference should however also be made to the independent

Expert Report prepared by Associate Professor David McKenzie, entitled T4 Project Health Assessment, which is provided in **Appendix D** of the RTS/PPR and provides a more in depth consideration of health issues (McKenzie, 2013).

### 4.12.1 Evaluation of Health Risks related to Fine Particles

Health effects related to particulate matter are addressed in **Appendix G** of the AQIA Report. An extract from this appendix is provided below to provide the basis for the response to submissions on this topic.

*Health effects related to particulate matter inhalation include exacerbation of existing pulmonary disease, oxidative stress and inflammation, changes in cardiac autonomic functions, vasculature alterations, translocation of particulate matter across internal biological barriers, reduced defence mechanisms and lung damage. Such effects have all been related to different levels of particulate exposure, as well as to different particle sizes and compositions. Most of the effects due to particles are associated with the exacerbation of existing disease states (CEPA, 1998; CARB, 2002; Morawska et al. 2005; Pope and Dockery, 2006; WHO, 2007; IAEA, 2008).*

*Factors influencing the likelihood, nature and magnitude of health effects due to particulate exposures include: toxicity and size of particles, susceptibility of persons exposed, and magnitude and duration of exposure.*

*Although health effects have been related to different particle sizes and compositions, the toxicity of particles and particle size (which influences patterns of deposition in and removal from the respiratory tract) have been found to be important for determining health effects. There is strong evidence to suggest that fine particles ($PM_{2.5}$) are more hazardous than coarser (2.5 to 10 µm) particles in terms of mortality and cardiovascular and respiratory endpoints (CEPA, 1998; WHO, 2003, 2004, 2007; US-EPA, 2006; Pope and Dockery, 2006). Coarse particles can however result in inflammation and other health responses, with clinical exposure of healthy and asthmatic humans to concentrated ambient air particles comprised mostly of $PM_{10-2.5}$ showing changes in heart rate and heart rate variability measures (CARB, 2002; US-EPA, 2006).*

*Contributing factors to the toxicity of particulate matter have been found in epidemiological and controlled exposures studies to include metal content, presence of polycyclic aromatic hydrocarbons, other organic components, acidic sulphates, endotoxin and both small (<2.5 µm) and extremely small size (<0.1 µm) (WHO, 2003; US-EPA, 2006). Epidemiological analyses and toxicology studies have however linked health outcomes with fine particulate matter from numerous sources including traffic-related pollution, regional sulphate pollution, combustion sources, resuspended soil and road dust (US-EPA, 2006).*

**Non-threshold Nature of Fine Particles and Evolving Approaches**

As indicated, health outcomes are associated with different levels of particulate matter exposures, including concentrations below air quality standards set by countries (including Australia) and air quality guidelines established by the WHO (WHO, 2006). This lack of an apparent threshold for adverse health effects poses a substantial barrier for establishing air quality standards that protect the public against effects (NEPC, 2011). WHO (2006) notes that in setting air quality standards, countries balance health risks, technological feasibility, economic considerations and various other political and social factors.

Growing recognition of the non-threshold nature of several priority pollutants has shifted the focus of air quality management to exposure reduction strategies. Such strategies seek to maximise overall health benefits, and provide the incentive for continuous improvement in air quality even in areas in compliance with air quality standards. Air quality standards remain however an important mechanism for managing peak exposures, supporting environmental equity and providing easily understandable information to the public. The integration of air quality standards and exposure reduction measures is being progressed by the EU as a means of achieving both efficiency and equity.

As part of the Air NEPM Review process it has been recently recommended that national standards be revised to include air quality standards and the incorporation of exposure reduction targets for priority pollutants. Exposure reduction approaches suitable for implementation within Australia are currently under review, with an initial focus on $PM_{2.5}$. It is envisaged that air quality standards will continue to be used for managing peak exposures.

**Overview of Particle Toxicity**

Particle toxicity relates to the particle size and composition. In terms of particle size, smaller particles, greater particle numbers and higher surface areas are indicative of greater toxicities. In terms of composition, high oxidative stress potential, high soot content and high concentrations of bioavailable transition metals are indicative of greater toxicities.

A comparison of the general formation pathways, composition, solubility, sources and atmospheric residence times of fine and coarse particles is given in **Appendix B** of this report as additional background information.

**Application of Air Quality Standards**

While recognising the non-threshold nature of several priority air pollutants, the AQIA was conducted in accordance with the *OEH Approved Methods for Modelling and Assessment of Air Pollutants in NSW*. Air quality standards are applied in NSW to evaluate existing air quality and changes in air quality due to new developments. Given the non-threshold nature of fine particles, all thresholds selected as the basis for air quality standards are risk-based.

Cumulative air pollutant concentrations projected to occur due to the T4 Project were assessed primarily based on the air quality impact assessment criteria documented within the *Approved Methods for Modelling*. In the case of $PM_{2.5}$, no criteria are published in the *Approved Methods for Modelling*, and reference was therefore made to the NEPM advisory reporting standards for $PM_{2.5}$.

Given that reference has been made to WHO air quality guidelines within various submissions, a comparison has been undertaken between air quality criteria for fine particles applied in NSW and WHO air quality guidelines in **Section 4.7.4** of this report. As discussed, the WHO guidelines for $PM_{2.5}$ are less stringently expressed compared to the NEPM advisory reporting standard. The WHO 24-hour guidelines for $PM_{10}$ is also less stringently expressed compared to the OEH 24-hour $PM_{10}$ criterion, but the WHO annual

$PM_{10}$ guideline is more stringent. The WHO guideline for annual average $PM_{10}$ is given as 20 µg/m³, with interim targets for annual average $PM_{10}$ being in the range of 30 µg/m³ to 70 µg/m³ to support progressive air quality improvements by countries. The OEH annual $PM_{10}$ criterion (30 µg/m³) is equivalent to WHO interim target 3.

### 4.12.2 Health Risks to Coal Dust and Applicability of Air Quality Standards

Several submissions make reference to specific health risks related to coal dust. Concerns are raised regarding the carcinogenicity of coal particles, heavy metals that may be present in coal dust, fine coal particles ($PM_{10}$, $PM_{2.5}$) and coarse particles (TSP).

A review of studies conducted into the health effects associated with coal dust was undertaken during the AQIA (Refer to **Appendix G** of the AQIA Report). The main aim of this review was to determine whether air quality standards for particulate matter afford equivalent protection in the case of exposures to coal particles.

Concerns raised within specific submissions in respect to the review presented in **Appendix G** of the AQIA Report are addressed below, and additional information provided in response to other issues raised.

***Issue – Is coal dust carcinogenic?***

As documented in Appendix G of the AQIA Report, according to the WHO International Agency for Research on Cancer (IARC), coal dust cannot be classified as to its carcinogenicity to humans (IARC 1997, IARC 2011). The recent National Institute for Occupational Safety and Health (NIOSH) meta study, which reviewed health studies for coal dust exposures published post 1995, supports IARC's findings (NIOSH, 2011).

Submission 461, p. 13 states that the literature review distorts the findings of NIOSH (2011). This submission extracts the following sentence from the NIOSH report to demonstrate this; "Lung cancer has been suspected to arise in coal miners because of their exposure to crystalline silica dust, which is a Group I carcinogen (p.25)". Taking this sentence out of context, Submission 461 does not accurately reflect the findings of NIOSH (2011).

For clarity, Section 4 of NIOSH (2011) entitled Cancer Outcomes is provided in its entirety below (p. 25) to convey the complete findings:

> *Two cancer outcomes—lung cancer and stomach cancer—have been of particular interest with respect to work in coal mining. Lung cancer has been suspected to arise in coal miners because of their exposure to crystalline silica dust, which has been determined to be a Group I carcinogen by the International Agency for Research on Cancer, at least in some occupational settings (77). However, findings in coal miners have been conflicting and have not strongly supported a relationship between coal mine dust exposure and lung cancer. The post-1995 findings continue this picture. No overall excess or relationship with increasing dust exposure was seen in lung cancer mortality in a study of U.S. underground coal miners (46). However, this study, lacking silica dust exposure measurements, could not effectively evaluate the hypothesis of interest. In contrast, a recent British study that did include cumulative crystalline silica dust exposures found a weak relationship of silica exposure with lung cancer mortality (47). A recent development in this regard is the finding that lung-deposited silica or*

*coal dust inhibits the induction of cytochrome P4501A1 by polycyclic aromatic hydrocarbons (PAH) (78–80). It is hypothesized that the resulting lower cytochrome activity might to some extent counteract the carcinogenic effects of tobacco smoke by limiting metabolism of PAH in tobacco smoke into carcinogenic metabolites. This may explain the lack of clear findings on dust exposure and lung cancer in coal mining.*

*There have been occasional reports of elevated stomach cancer mortality among coal miners. The post-1995 results from various reports have not confirmed these findings. In particular, no relationship was detected in the two studies having quantitative exposure measurements (46, 47).*

Referencing the recent meta study conducted by NIOSH (2011), and the on-going classification by IARC, ENVIRON concluded that coal dust cannot be classified as to its carcinogenicity to humans. No evidence was provided within submissions to contradict this conclusion.

***Issue – Effects related to silica content of coal***

Crystalline silica has been classified as a human carcinogen and inhalation of crystalline silica dust is associated with silicosis. There are several crystalline forms, including quartz, cristobalite and tridymite.

Coal mine dust contains crystalline silica (quartz), however the *in vitro* toxicity of coal mine dust has been found to differ from that of pure crystalline silica (WHO, 2000). Coal dust contains clays and silicate minerals that are considered to reduce the toxicity of the silica contained within the mixed dust (Borm, 1997; Thompson et al., 2007; WHO, 1986; Mossman and Churg, 1998). Coal dust containing small quantities of quartz have been found to display relative low level toxicity compared to pure crystalline silica. Referencing evidence from studies in the coal industry Thompson *et al.* (2007) notes that risks of quartz inhalation are reduced if the mixed dust inhaled also contains silicate minerals, such that coal dust concentrations comprising up to 10% quartz were not associated with a silicosis risk. However, where quartz exposures are high (e.g. coal mine dust containing 25% to 30% quartz), the presence of other components such as coal and even clay minerals does not necessarily protect against silicosis.

A recent study was conducted by Morrison and Nelson (2011) to assess crystalline silica particle exposures in close proximity to Hunter Valley open-cut coal mines. This study was prompted by media reports of high levels of silicon in particles in the air in the vicinity of Hunter Valley open-cut coal mines which caused community anxiety and concerns about potential health impacts on local populations. The study determined that silicon as silica was present in the ambient air, although the concentrations of crystalline silica measured suggest that it should not cause health problems even for sensitive individuals within the general population (Morrison and Nelson, 2011).

Respirable crystalline silica is primarily produced during specific coal mining processes, notably cutting, drilling, crushing, grinding and milling. The T4 Project will not involve these activities.

***Issue – Carbonaceous particles such as diesel soot (and likely coal dust) have a more significant health impact than general/other ambient aerosols – Submission 329***

Diesel particulate matter is addressed in the following sub-section. No evidence could be identified during the literature review to indicate that the composition of coal dust from coal handling and storage operations is more hazardous to human health than ambient urban particles[(4)]. Nor was any specific evidence referred to in the submissions received or in the publications referenced in such submissions. Thus the application of TSP, $PM_{10}$ and $PM_{2.5}$ air quality standards is considered applicable for the assessment of coal dust associated with the T4 Project.

### 4.12.3 Health Risks to Diesel Particulate Matter

Diesel particulate matter (DPM) is considered to comprise a particularly significant health risk due to the particle size distribution and chemical composition of such particulates. DPM is dominated by fine and ultra-fine particles, the composition of which may include elemental carbon with adsorbed compounds such as organic compounds (including potentially carcinogenic organic compounds such as polycyclic aromatic hydrocarbons), sulphate, nitrate, metals and other trace elements. In June 2012 the International Agency for Research on Cancer concluded that diesel engine exhaust be classifiable as carcinogenic to humans (Group 1), based on sufficient evidence that exposure is associated with an increased risk for lung cancer[(5)]. It was also noted to have a positive association (limited evidence) with increased risk of bladder cancer. The IARC study will be published as Monograph 105.

DPM is a typical constituent of ambient fine particulate matter in urban areas, and is expected to contribute some of the health effects associated with $PM_{2.5}$ (NEPC, 2010; US-EPA, 2002). In the US, DPM has been quantified to comprise about 10% of $PM_{2.5}$ and in some cases as high as 36% (US-EPA, 2002). The current DPM component of ambient $PM_{2.5}$ could not be established for Newcastle or other Australian cities based on a review of the literature. Based on the $PM_{2.5}$ characterisation and source apportionment work undertaken by ANSTO (2010) for Mayfield, the black carbon content of $PM_{2.5}$ was recorded to be 16±6%; however diesel combustion and other combustion sources contribute to ambient black carbon concentrations. Vehicles, including gasoline- and diesel-powered vehicles, were estimated to contribute 27% of the ambient $PM_{2.5}$ measured at Mayfield (as documented in **Section 5.2.3** of the AQIA Report).

The AQIA predicted ambient $PM_{10}$ and $PM_{2.5}$ concentrations occurring due to T4 Project related emissions, including DPM and coal dust emissions, and evaluated predicted total particulate matter concentrations based on the OEH impact assessment criteria for $PM_{10}$ and the NEPM advisory reporting standard for $PM_{2.5}$. DPM comprised primarily $PM_{2.5}$. Diesel exhaust emissions from rail locomotives within the T4 Project area, ships at berth, and construction plant were accounted for and predicted levels complied with the relevant criteria and standard.

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[4] An overview of the typical composition of airborne particles in urban areas is provided in **Appendix B** of this report.

[5] IARC (2012). IARC WHO Press Release No. 213, IARC: Diesel Engine Exhaust Carcinogenic, 12 June 2012, World Health Organisation, International Agency for Research on Cancer, Lyon, France.

### 4.12.4 Calls for a Health Risk Assessment / Health Impact Assessment

A number of submissions call for a more comprehensive assessment of the overall health effects associated with the T4 Project. In summary, submissions specified that the following be addressed by a comprehensive assessment of health effects:

- Profiling of the current health status of people in Newcastle, particularly in regard to inhalation exposures and people living in proximity to the port and the rail corridor.
- Health impact assessment of vulnerable populations (children, aged, people with existing respiratory and cardiovascular morbidity).
- Consideration of a range of health endpoints including asthma, respiratory ailments and cardiovascular illness.
- Consideration of the health effects of short term spikes in air pollution, e.g. sub-hourly peaks in DPM in proximity to the rail corridor.
- Health effects related to particle exposures, including coal dust, diesel exhaust emissions, and fine and ultra fine particles. I.e. estimation of morbidities and mortalities related to T4 Project emissions.
- Cumulative health effects taking into account: air pollution (impacts on health and amenity), noise, light pollution, traffic congestion, and sleep disturbance.

Submission 461 (Newcastle Public Health Professionals) states that air quality modelling alone is not sufficient and that a "proper best practice Health Impact Assessment, that includes equity aspects, is required as an essential component of the EA" (p. 7). This submission and Submission 329 (Doctors for the Environment Australia) argue for the adoption of the *2001 Health Impact Assessment Guidelines* published by the Commonwealth of Australia. Reference was also made to the *Health Impact Assessment: A Practical Guide* published by Harris *et al*. (2007).

The EARs did not require a health impact or health risk assessment however, in response to these submissions Associate Professor David McKenzie was engaged to consider potential impacts on respiratory health and his findings are in Appendix D of the RTS/PPR. Reference should be made to this independent expert report for further discussion of health risk issues identified. Health effects relating to particulate matter are also addressed in Appendix G of the air quality assessment in Appendix M of the EA.

# 5 Conclusions and Recommendations

Issues raised in relation to the Air Quality Impact Assessment for the T4 Project were grouped by category and responded to within this document. Issues identified for possible further consideration are summarised below.

## 5.1 Cumulative rail corridor impacts and rail wagon dust control measures

Related issues are discussion in **Sections 4.4, 4.5** and **4.10** of this Report. The scope of the AQIA was restricted to the consideration of impacts in close proximity to the rail corridor due to coal dust from rail wagons, and diesel exhaust emissions from locomotives within the T4 project area. The AQIA does not address all concerns raised regarding cumulative air quality impacts along the rail corridor. This issue is however being investigated by OEH and ARTC, with these investigations being used to inform the need for and nature of rail-related management measures required. The management of dust and other air emissions from rail wagons outside of the T4 project area is the responsibility of the ARTC and rail freight operators.

## 5.2 Potential for Mobilisation of Toxic Contaminants during Construction

Related issues were addressed in **Section 4.11** of this Report. At the time the AQIA was conducted there was insufficient data to support the estimation and modelling of potential trace emissions to quantify the risk (ENVIRON, 2012a). Lack of data similarly precluded the quantitative assessment of risk during the air quality assessment conducted for the Modified T4 Project (ENVIRON, 2013). Effective management during the construction period will however render the potential for risk to be low.

The RAP and the site-specific MMP to be included in the CEMP will detail management measures for the project's earthworks to minimise the potential for trace metal/metalloid and odour emissions. It is recommended that this incorporate outcomes of more detailed sampling and contaminant testing in the areas proposed to be excavated.

## 5.3 Additional Contingency Measures

The EPA submission (G441) recommends that PWCS identify additional mitigation measures to be employed during weather conditions where the NEPM goal is likely to be exceeded (Refer to **Section 4.10** of this Report). The potential exists for an increase in the frequency of extreme weather events due to projected climate change (Refer to **Section 4.8.1** of this Report).

PWCS has committed to the implementation of a reactive/predictive air quality control system to inform the need for contingency measures. The main contingency measure proposed for implementation during adverse meteorological conditions is the intensification of wet suppression measures. According to Kruse (2012) this measure is able to achieve dust control efficiencies of greater than 80%. In the event that intensification of wet suppression is determined to be insufficient given future adverse meteorological conditions, additional measures available for consideration include coal moisture adjustment (requires coal moisture conditioning system).

## 5.4 Health Effects and Risks

Related issues are discussed in **Section 4.7.4** and **Section 4.12** of this Report. A number of submissions called for an assessment of existing health effects and a comprehensive assessment of the overall health risks and effects associated with the T4 Project. The completion of a health risk assessment, or a broader health impact assessment, was not required by the Director General's EARs. Considering the health related concerns raised in submissions, Associate Professor David McKenzie was engaged to consider potential impacts of the T4 Project on respiratory health (McKenzie, 2013). Reference should be made to this independent expert report for further discussion of health risk issues identified.

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# 7 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to PWCS (proposal number 2231, dated 9 July 2012) and in accordance with our understanding and interpretation of current regulatory standards.

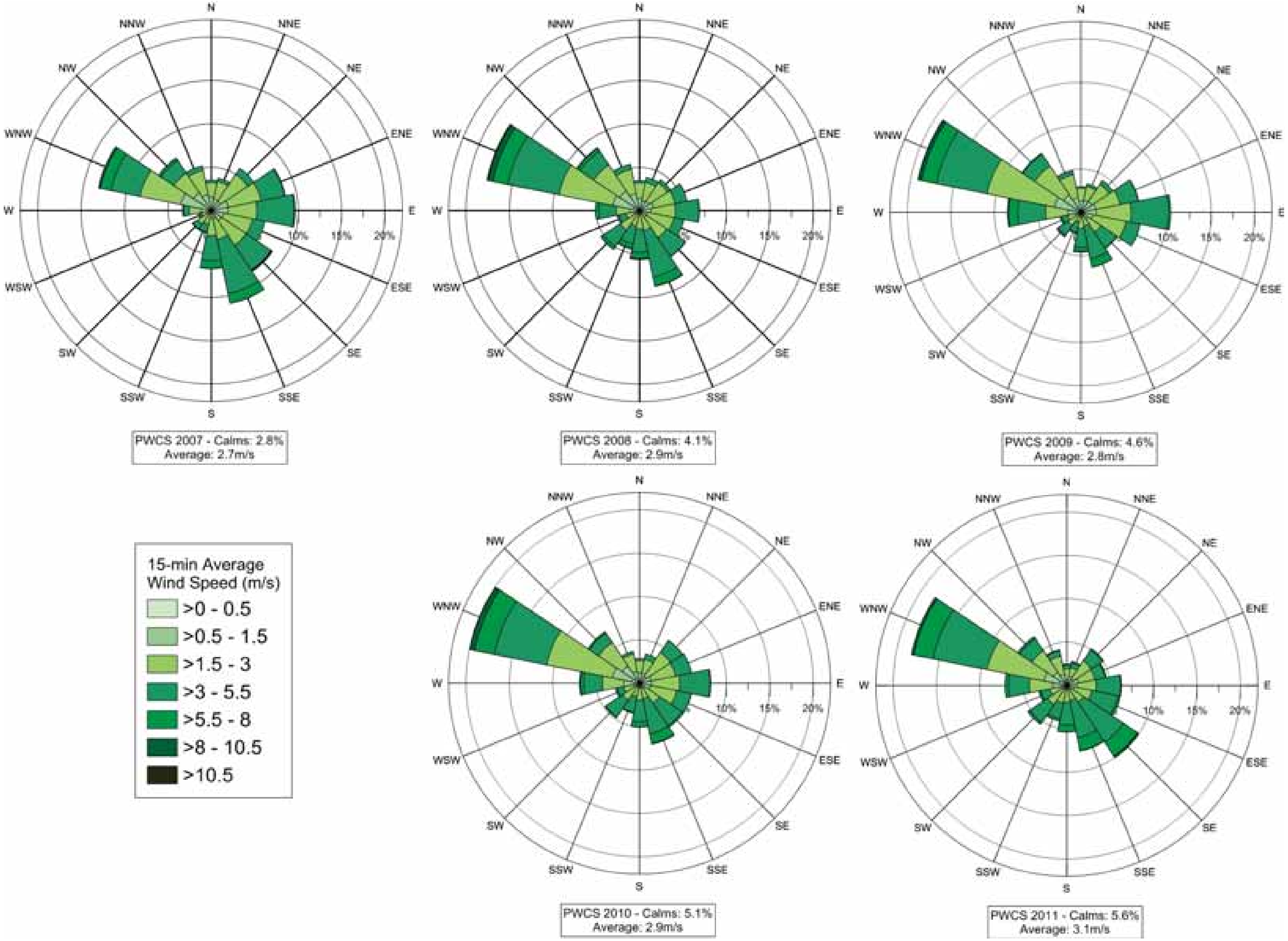
The conclusions presented in this report represent ENVIRON's professional judgment based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of issue of this report.

ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

# Appendix A

## KCT Meteorological Station – Annual average wind roses (2007-2011)


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
10%
15%
20%
PWCS 2007 - Calms: 2.8%
Average: 2.7m/s
PWCS 2008 - Calms: 4.1%
Average: 2.9m/s
PWCS 2009 - Calms: 4.6%
Average: 2.8m/s
PWCS 2010 - Calms: 5.1%
Average: 2.9m/s
PWCS 2011 - Calms: 5.6%
Average: 3.1m/s
15-min Average
Wind Speed (m/s)
>0 - 0.5
>0.5 - 1.5
>1.5 - 3
>3 - 5.5
>5.5 - 8
>8 - 10.5
>10.5

# Appendix B

## Background Information on Airborne Particulate Matter

**Particle Terminology**

Atmospheric aerosols consist of particles ranging in size from ~ 0.001 to 500 µm. Particles smaller than 2.5 µm are generally referred to as "fine", and those greater than 2.5 µm as "coarse" particle modes.

Ultrafine particles are defined as particles smaller than 0.1 µm, with particles with diameters below 50 nm (0.05 µm) being termed nanoparticles.

**Particle Formation, Composition and Removal from the Atmosphere**

Fine and coarse particle modes (and ultrafine and nanoparticles) generally differ in:

- origin
- method of transformation and removal
- chemical composition
- optical properties
- deposition patterns in the human respiratory tract

Fine particles are typically divided into two modes, viz. the nuclei and accumulation modes.

*Nuclei mode:*

- Extending from ~0.005 to 0.1 µm diameter - accounts for the preponderance of particles by number.
- Due to their small size, these particles rarely account for more than a few percent of the total mass of airborne particles.
- Formed from the condensation of hot vapours during combustion processes and from nucleation of atmospheric species to form fresh particles.
- Typically 'lost' by coagulation with larger particles.

*Accumulation mode:*

- Particles in range of 0.1 to 2.5 µm diameter.
- Usually accounts for most of the aerosol surface area and a substantial part of the aerosol mass.
- Sources include coagulation of particles in the nuclei mode and from condensation of vapours onto existing particles causing them to grow into this size range.
- Particle removal mechanisms are least efficient in this regime - causing particles to accumulate there (hence the name of this mode).

*Coarse mode:*

- Formed by mechanical processes - usually consists of man-made and natural dust particles.

- Have sufficiently large sedimentation velocities that they settle out of the atmosphere in reasonable short time.

The dominant mechanisms responsible for removing particles from the atmosphere are illustrated in **Figure B1**.

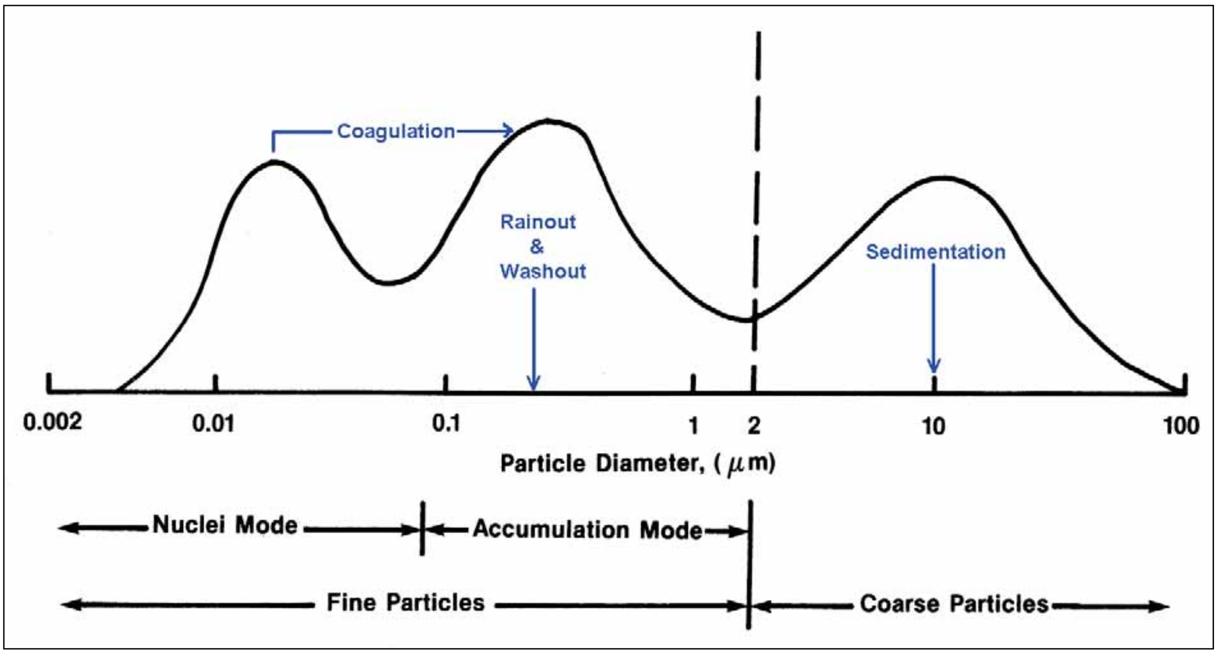



**Figure B1. Particle removal mechanisms**

***Nucleation*** - process whereby molecules produced by gas-phase reactions collide to form particles.

***Coagulation*** - process of collision and adhesion of particles to form much larger particles. Coagulation is rapid if the particle number is high, e.g. with a concentration of N = $10^{14}/m^3$ it takes 20 seconds to half the particle number.

***Condensation*** on existing particles - further particle growth mechanism.

***Sedimentation*** - all particles settle with a velocity which can be determined by equating the gravitational force with the drag force. The settling velocity is important for particles larger than ~1 µm, e.g. a 3 µm particle takes 9 hours to settle a distance of 200 m.

***Rainout*** - removal through incorporation into raindrops as condensation nuclei. Particles in the 0.1 µm diam size range, particularly sulphate particle, represent effective condensation nuclei. Smaller particles rapidly diffuse to cloud droplets.

***Washout*** - removal by raindrops (beneath cloud) - effective for larger particles such as ammonium sulphate and sodium chloride aerosols.

***Deposition*** - For large particles, sedimentation (gravitational settling) limits the lifetime of particles considerably. Diffusion to and *impaction* with surfaces and ground is more important for smaller particles.

A comparison of the formation pathways, composition, solubility, sources and atmospheric residence times of fine and coarse particles is given in **Table B1**. The mass distribution and typical composition of airborne particles in urban areas is illustrated in **Table B2**.

**Table B1 - Comparison of Ambient Fine and Coarse Particles**

| | Fine Particles | Coarse Particles |
|---|---|---|
| *Formation pathways* | chemical reactions<br>nucleation<br>condensation<br>coagulation<br>cloud/fog processing | mechanical disruption<br>suspension of dust |
| *Composition* | sulphate<br>nitrate<br>ammonium<br>hydrogen ion<br>elemental carbon<br>organic compounds<br>water<br>metals (Pb, Cd, V, Ni, Cu, Zn, Mn, Fe, etc.) | resuspended dust<br>coal and oil fly ash<br>crustal element (Si, Al, Ti, Fe) oxides<br>pollen, mold, spores<br>plant and animal debris<br>tire wear debris |
| *Solubility* | largely soluble, hygroscopic | largely insoluble and non-hygroscopic |
| *Sources* | combustion (coal, oil, gasoline, diesel, wood)<br>gas-to-particle conversions of NOx, $SO_3$ and VOCs<br>smelters, mills (etc.) | resuspension of industrial dust and soil<br>suspension of soil (farming, mining, unpaved roads)<br>biological sources<br>construction/demolition<br>ocean spray |
| *Atmospheric lifetime* | days to weeks | minutes to days |
| *Travel distance* | 100s to 1000s of km | < to 10s of km |

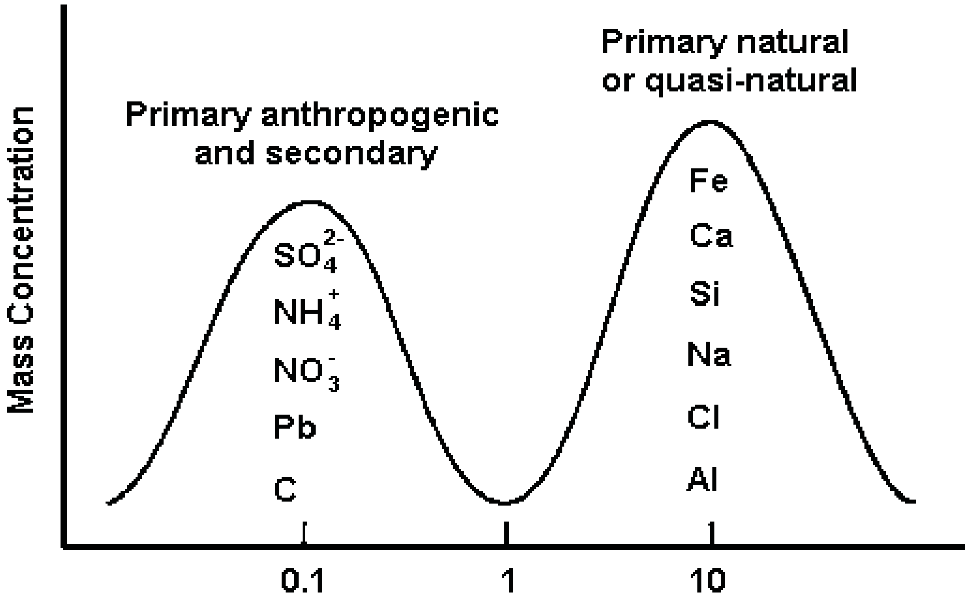



**Figure B2. Mass distribution of fine and coarse particles in urban atmosphere and associated composition**

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