FINAL

Particulate Modelling Assessment for Proposed Mining Operations 15 Mtpa Scenario

Prepared for:
Australian Premium Iron Management Pty Ltd
Perth, WA

Prepared by:
ENVIRON Australia Pty Ltd

Date:
16 March 2012

Project Number:
AS110525

FINAL

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VERSION CONTROL RECORD

Document File Name	Date Issued	Version	Author	Reviewer
AS110525_API Management Dust Assessment – Hardey 15 Mtpa_070611_D1.doc	17 June 2011	External Draft 1	Anthony Lazarus	Yvonne Scorgie
AS110525_DRAFT API Dust Assessment_Hardey Mining Site Operations 15 Mtpa_20111128.docx	28 November 2011	External Draft 2	Anthony Lazarus	Brian Bell
AS110525_DRAFT API Dust Assessment_Hardey Mining Site Operations 15 Mtpa_20120316.docx	16 March 2012	External Final	Anthony Lazarus	Brian Bell

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1 Introduction

1.1 Background

Australian Premium Iron Management Pty Ltd (API) is proposing to mine, process and produce up to 15 million tonnes per annum (Mtpa) of iron ore at the proposed West Pilbara Iron Ore Project Stage 2 Hardey Development (the 'Hardey Development'), located approximately 55 km south-west of Tom Price, Western Australia.

ENVIRON Australia Pty Ltd (ENVIRON) was requested by API to undertake air dispersion modelling of fugitive dust emissions from the proposed Hardey Processing Facility (HPF) to assess the potential ambient air quality impacts associated with the mining and handling of up to 15 Mtpa of iron ore.

1.2 Purpose of this Report

The purpose of this report is to present the results of the air dispersion modelling study and to assess the potential impacts on ambient air quality resulting from fugitive dust emissions associated with the mining, processing, stockpiling and handling of up to 15 Mtpa of iron ore. An on-site diesel-fired power station will supply power for the HPF and a workers camp will be located approximately 4 km east-northeast of the mining operation. The atmospheric emissions from the power station have been included in this assessment.

Dust will be the key emission from the site during construction. However, the relatively short construction timeframe and the management measures that will be put in place will mean that these emissions are not expected to be significant. Therefore, the construction phase of the project has not been included in the air dispersion modelling.

During operations, the site will generate dust emissions from a range of activities including blasting, drilling and material movement in the open pits; transfer of material via haul trucks to the waste rock dump and the crushing facilities; crushing (primary, secondary and tertiary); screening and stockpiling the ore; and conveying and loading the material to rail.

Air dispersion modelling has been completed to predict short-term and long-term ambient ground level concentrations (GLCs) of total suspended particulate (TSP), particulate matter less than 10 µm in equivalent aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 µm in equivalent aerodynamic diameter ($PM_{2.5}$) across the modelled domain. The air dispersion model has also been utilised to predict particulate deposition rates in order to determine the potential impact of particulate deposition on the surrounding environment.

Air dispersion modelling has also been used to predict the ground level concentrations of products of combustion such as carbon monoxide (CO), oxides of nitrogen (NO_x) and sulphur dioxide (SO_2) that will occur as a result of the emissions from the on-site power station.

1.3 Site Description and Proposed Facility Layout

A geographical map for the area is presented as Figure 1, illustrating the terrain of the project site and the surrounding areas. A layout of the proposed facility is presented as

Figure 2 and a process flow diagram for the 15 Mtpa iron ore processed is presented as Figure 3.

2 Ambient Air Quality Standards

Particulate matter can remain suspended in the air for a period of time and can consist of a range of matter including crustal material, pollens, sea salts and smoke from combustion products. Particulate matter is commonly defined by the size of the particles, measured as:

- TSP, refers to total suspended particulates with such particulates being defined as primarily comprising particulate matter with an equivalent aerodynamic particle size below 50 μm diameter. The term equivalent aerodynamic particle is used to reference a spherical shaped particle and a density of 1 g/cm^3
- PM_{10}, refers to particulate matter 10 μm in equivalent aerodynamic diameter or less
- $PM_{2.5}$, refers to particulate matter 2.5 μm in equivalent aerodynamic diameter or less.

TSP, which contains both the PM_{10} and $PM_{2.5}$ fractions, is normally associated with nuisance impacts such as dust fallout and soiling of washing. PM_{10} and $PM_{2.5}$ are associated with potential for health impacts, as finer particle fractions can enter deeper into the lungs.

2.1 Ambient Air Quality Criteria

The National Environment Protection Council (NEPC) has produced national ambient air quality standards related to particulates for the protection of human health. These include the National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPC, 2003), which sets national air quality standards for the criteria pollutants including particulates (as PM_{10}), and the Variation to the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2002,) which sets an advisory reporting standard for $PM_{2.5}$. These standards have primarily been derived from health studies in major urban centres where the particulate matter primarily consisted of combustion products from vehicles, industry and smoke from various burning activities. The purpose of the $PM_{2.5}$ advisory standard is to gather sufficient data to facilitate a review of the Standard as part of the review of the ambient air quality NEPM. The Western Australian State Government has adopted the NEPM standards for ambient air quality as part of the *State Environmental (Ambient Air) Policy 2009* (EPA, 2009) and the NEPM standards for PM_{10} and $PM_{2.5}$ have subsequently been applied in this assessment.

In addition to the NEPC NEPMs, the Western Australian Environmental Protection Authority (EPA) has established an Environmental Protection Policy (EPP) which provides ambient air quality standards for TSP and sulphur dioxide for Kwinana (EPA, 1999). These standards were established in order to maintain acceptable air quality within and around the Kwinana Industrial Area. The Kwinana EPP defines three regions; the industrial zone (Area A), the buffer zone surrounding heavy industry (Area B) and the rural and residential zone (Area C). In the absence of national ambient air quality standards for TSP, the EPA's standard for TSP within the buffer zone surrounding industrial zone (Area B) has been adopted for the purpose of this assessment.

The NEPC and Kwinana EPP ambient air quality standards for particulates relevant to this study are provided in Table 1.

Table 1: Particulate Ambient Air Quality Standards

Pollutant	Averaging Period	Standard (µg/m^3)	Goal	Reference
TSP	1 day	90[1]	NA	EPA (1999)
Particles as PM_{10}	1 day	50	5 days a year	NEPC (1998)
Particles as $PM_{2.5}$[2]	1 day	25	To gather sufficient data to facilitate a review of the standard	NEPC (2002)
	1 year	8		

References
[1]. Kwinana EPP Area B and C (Buffer and Rural/Urban Zones) standard.
[2]. $PM_{2.5}$ standards are advisory reporting standards.

The NEPM also sets national standards for other criteria pollutants (including carbon monoxide, sulphur dioxide and nitrogen dioxide), which are applicable in this study as seen in Table 2.

Table 2: Ambient Air Quality Standards

Pollutant	Averaging Period	Standard (µg/m^3)	Goal	Reference
CO	8 hours	10,000	1 day a year	NEPC (2002)
NO_x as NO_2	1 day	246	1 day a year	
	1 year	62	None	
SO_2	1 hour	572	1 day a year	
	1 day	228	1 day a year	
	1 year	57	None	

Notes
1.NEPM Standard has been converted to µg/m^3 at 0 and 101.3 kPA

2.2 Particulate Deposition Guidelines

The New South Wales Office of Environment and Heritage (OEH) specifies dust deposition criteria in its guideline *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005) as detailed in Table 3. These criteria are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research and Demonstration Council (NERDC, 1988) and take into account potential amenity impacts. While the dust deposition guideline is expressed as g/m^2/month, the NSW OEH has indicated that the monthly average deposition (to be compared against the guideline value) is to be determined from data spanning no less than one year, so as to account for seasonal variations.

Table 3: Dust Deposition Criteria

Pollutant	Averaging Period	Criteria ($g/m^2/month$)
Deposited Dust[1]	Annual (increase)[2]	2
	Annual (total)[3]	4

References

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

Notes

[1]. Dust is assessed as insoluble solids as defined by AS 3580.10.1-1991 (AM-19).

[2]. Maximum increase in deposited dust level.

[3]. Maximum total deposited dust level.

3 Proposed Operations

3.1 Production and Throughput

The proposed HPF will process ore mined from the Hardey Development and for the purposes of this report an upper throughput limit of 15 Mtpa has been assumed. The HPF design is based on a plant capacity of 2,654 tph (dry)m a feed moisture content of between 0.6% and 3.0%, and a feed size of <850 mm. The plant is currently proposed to operate for 6,500 hours per year over a 10 year period.

3.2 Description of Ore

Preliminary testing of ore samples has been carried out to determine the moisture level required to ensure practical dust extinction during material handling. The results of these tests indicate that the dust extinction moisture (DEM) level for the West Pilbara ore is 7.6% for the particle size fraction less than 6.3 mm.

API has indicated that while the moisture level of the ore above the water table is expected to be between 0.6% and 3%, additional moisture will be added to the ore at the mine site such that the railed pisolite product is expected to have a moisture content of approximately 6%.

3.3 Proposed Mining Operations

Ore will be hauled from two mine pits to the run of mine (ROM) pad by off-highway rear-dump trucks. The ore will then be fed from the ROM pad via a hydraulic loader and two 135 t haul trucks to the crushing and screening circuit. The crushing and screening circuit will consist of a primary jaw crusher, secondary and tertiary crushers and double deck screens. The crushing and screening facilities will have dust extraction systems installed to minimise dust emissions and return agglomerated dust paste to the ore stream. The operation of the processing plant will be automated and the reclaim, crushing and screening facilities are expected to operate for 6,500 hours per year. The process plant will be a standard three stage crushing and screening plant that accepts ROM ore from the pit, and crushes to a single product size using screens to control product size. No beneficiation is proposed and all of the plant feed will be converted to product.

The iron ore product will be conveyed to the rail stockpile and deposited via a stacker. The stacker will be fitted with discharge water sprays to control dust emissions. The trains will be loaded using front-end loaders (FELs) for transport to the port facility.

An onsite diesel-fired power station will supply power for the site, accommodation village and workers camp (during construction). The accommodation village and workers camp will be located approximately 4 km east-northeast of the mining operation.

3.4 Potential Dust Sources

The main potential sources of dust emissions and the proposed dust control measures that will be utilised at HPF are described in the following sections. The control efficiencies of the proposed dust control measures are primarily based on the National Pollutant Inventory (NPI)'s estimated control factors for mining activities (NPI, 2011). However, the results of dust emissions testing for iron ore stockpiling and material handling, as published by Pitts (2001) are also used. Potential sources of dust include:

- drilling in open pits
- blasting events in open pits
- movement of material in pits (i.e. into haul trucks)
- ore/waste rock excavation
- ore/waste rock dumping onto stockpiles
- ore crushing and screening
- conveyor operations
- wheel generated dust from truck movements
- train loading
- wind erosion from cleared areas and ore/waste stockpiles.

3.4.1 Blasting and Drilling

Blasting of ore is proposed to occur five days per week and only once per day. Dust emissions from blasting are difficult to model due to the short-time interval and variability of the physical factors that define a blast event. Blasting activities are episodic in nature and the impacts are generally short-term, resulting from a distinct event at a specific location. There are greater uncertainties with calculating dust impacts from blasting than there are with other longer-term activities of the mining operations as a whole.

Details of the blasting area have been determined based on the annual amount of material to be blasted and the blasting schedule. The average total area per blast is 3163 m^2. The blasts were proportionally split among the two pits. For the purposes of this assessment, blasting was assumed to occur five days a week at 1 pm.

Drilling activities were also estimated based on the total amount of material and the dimensions of the blast area. Drilling was assumed to occur on a continuous basis with drill holes spaced at five meters apart. Emissions from drilling were estimated based on NPI Emission Estimation Technique Manual (EETM) for Mining v3.0 (NPI, 2011).

3.5 Ore/Waste Loading of Trucks

Removal of ore and waste rock from the pits has been modelled as a material being lifted and loaded in haul trucks. The emission factors from the NPI EETM for Mining v3.0 (NPI, 2011) were used in conjunction with the total amount of material to be moved.

3.6 Ore/Waste Material Dumping

Ore and waste rock that is removed from the pits will be transported to the ROM stockpile at the primary crusher or to the waste rock dump respectively. Dust suppression is provided by deluge spray, which is trigged during dumping at the ROM hopper. Emissions from loading and unloading of waste rock from haul-packs were calculated by using the emission factor from the NPI EETM for Mining v3.0 (NPI, 2011) and the rate of waste rock dumping.

3.7 Ore Crushing and Screening

Ore from the mine is considered to be high moisture content ore for emission estimation purposes (as water is going to be added at the mine as required). The NPI EETM for Mining v3.0 (NPI, 2011) provides emission factors for crushing and screening based on the moisture content of the ore. For primary crushing of high moisture content ores, the PM_{10} default emission factor is given as 0.004 kg/t. For secondary crushing of high moisture content ores, the PM_{10} default emission factor is given as 0.012 kg/t. Crushing and screening was estimated to occur for only 6,500 hours per year but were conservatively modelled as occurring for the entire year. Dust extraction from the emissions was included for the crusher at the conveyor loading point and also at the discharge/transfer point.

3.7.1 Loading to Trains

The train consists of 168 ore wagons hauled by two locomotives. Train cars will be loaded by FELs from the fines stockpile. The FELs load the train at an average rate of 4,000 tph (wet) with ore at a target moisture content of 6%. Each train will be loaded over a period of five hours. It is anticipated that three trains will be loaded each per day, each having a 20,000 t hauling capacity.

Emissions from loading ore to rail cars were calculated using the default emission factor for FEL loading to trains as is provided in the NPI EETM for Mining v3.0 (NPI, 2011).

3.7.2 Conveyor Transfer

Conveyor transfer points are potentially a large source of dust emissions. Emissions from transfer points can arise following the initial start up, where dust that has dried out on the conveyor and falls off at the belt return, or can occur as material falls off at the belt idlers on the return belt, or via winnowing.

At the HPF, ore will be conveyed from the primary crusher to the secondary and tertiary crusher and from these crushers to the screening building. It is anticipated that two transfer stations will be utilised.

Both transfer points will be enclosed and the control efficiency adopted for these sources for modelling purposes is 75%. This is less than the 100% recommended by the NPI (2011) for a totally enclosed system to allow for dust emissions that may escape through the conveyor entry and exit openings and to ensure that the emissions estimates remain conservative.

3.7.3 Conveyor Belts

When exposed to high winds, some types of material on conveyor belts can be lifted off creating nuisance impacts, particularly if conveyors are high and exposed to strong winds or the material being conveyed is prone to dusting.

The European Commission has published a series of publications on Integrated Pollution Prevention and Control, including "Reference Document on Best Available Techniques on Emissions from Storage" (European Commission, 2006). This document addresses the control of dust from conveying systems and states that "a main source of dust emissions from belts is when the returning part of the belt comes into contact with the support pulleys." This is consistent with the findings at both Rio Tinto and BHP Billiton's operations in the Pilbara region, where the use of belt scrapers and washers have been key elements in the control of dust sources from conveyors.

The European Best Available Techniques (BAT) document defines the depressiveness of bulk material as follows:

> "The following classification, based on the susceptibility of a material to be dispersed and the possibility of dealing with the problem by wetting, is used for non-reactive products:
>
> – S1: highly drift sensitive, not wettable
>
> – S2: highly drift sensitive, wettable
>
> – S3: moderately drift sensitive, not wettable
>
> – S4: moderately drift sensitive, wettable
>
> – S5: not or very slightly drift sensitive."

The European Commission's BAT document defines BAT for conveyors and transfer chutes as follows:

> "For all types of substances, BAT is to design conveyor to conveyor transfer chutes in such a way that spillage is reduced to a minimum. A modelling process is available to generate detail designs for new and existing transfer points.
>
> For non or very slightly drift sensitive products (S5) and moderately drift sensitive, wettable products (S4), BAT is to apply an open belt conveyor and additionally, depending on the local circumstances, one or a proper combination of the following techniques:
>
> – lateral wind protection
>
> – spraying water and jet spraying at the transfer points, and/or
>
> – belt cleaning."

The European BAT document provides information on depressiveness classes of solid bulk materials and categorises a wide range of different iron ore types within the S4 and S5 dispersive classes. This is consistent with the experience in the Pilbara where moisture content of the ore is a significant factor in the control of fugitive iron ore emissions.

Therefore, based on the European Best Available Practice documentation the management of transfer points (use of sprays or enclosing), return conveyor dust (belt scrapers/washing), and maintaining moisture in the ore are key to minimising dust from conveyor operations. With these controls in place, the amount of dust expected to be generated from uncovered conveyors would be negligible from a modelling perspective.

As such, the current modelling has not considered the conveyors (other than the transfer points) and has focused on the key potential fugitive dust generation sources, which include the train unloading, stacking and reclaiming to/from the stockpiles and the material transfer points.

3.7.4 Stockyards

The majority of ore hauled to the HPF will be dumped directly into the ROM hopper for the plant feed. However, approximately 30% of the ore will be dumped at the ROM pad stockpile and re-handled with FELs for blending purposes.

In addition, a single product stockpile pad will be constructed for the 15 Mtpa product scenario. The FELs are expected to load material at a nominal rate of 4,000 tph.

3.7.5 Stacking

The fines product is conveyed to a slewing and luffing stacker for placement into a 150 kt stockpile located along side the rail line.

In addition to the controlled drop height, the stacker will be fitted with spray heads to further minimise dust emissions. The control efficiency adopted for modelling purposes for these measures is 75%. While slightly higher than the 62.5% control suggested by the NPI (2011) for coal stockpiling based on the use of water sprays and variable height stackers, the 75% control is in line with the factors suggested by Pitts (2001) for iron ore stacking operations employing similar dust control measures.

3.7.6 Vehicles and Wheel Generated Dust

Emissions from vehicles travelling along all haul roads at, and between, the pits, the waste rock dumps and the ROM area have been estimated using the equation developed by the USEPA and provided in the NPI EETM for Mining v3.0 (NPI, 2011).

Total vehicle kilometers travelled (VKTs) for haul trucks were based on each truck driving over a haul road to either a waste rock dump or the primary crusher.

A fleet of approximately 18 haul trucks (135 tonnes each) will be in operation at the HPF under the 15 Mtpa product scenario. Dust suppressants will be used on unsealed roads.

3.8 Power Station

Power will be generated at a centralized on-site diesel power station. The design of the power station is based on a peak power demand of 11 MW. The maximum installed capacity of the station will be 14.4 MW using nine 1.6 MW generators. Eight of the generators will be active during peak load with one on standby to provide an annual power demand of 76,200 MWhr. Emission rates for the proposed power station along with stack specifications were provided by API.

4 Modelling Methodology

4.1 Air Dispersion Model

Potential air quality impacts from the HPF have been estimated using the Victorian Environmental Protection Agency (VEPA)'s Gaussian plume dispersion model Ausplume (Version 6.0). Ausplume is regularly used for assessing impacts from industrial sites within Australia and has been used for similar assessments in the Pilbara region, including Fortescue Metals Group (FMG)'s impact assessment of its port facilities (ENVIRON, 2004) and BHP Billiton's Port Hedland Outer Harbour Development – Dust Modelling and Assessment (BHP Billiton, 2011).

4.2 Meteorological Data

The Ausplume model requires time series air quality meteorological data, including hourly averaged values of:

- wind speed and direction
- ambient air temperature
- Pasquill-Gifford stability class
- atmospheric mixing height.

In the absence of site specific data and upper wind information, CSIRO's The Air Pollution Model (TAPM) was selected to generate the meteorological dataset for Ausplume. DEC Air Quality Modelling Guidance (2006) state that TAPM is not accepted to model dispersion of low sources with zero or low buoyancy either directly or indirectly (e.g. TAPM producing a meteorological file for another model) unless performance of the model is demonstrated to be reliable, or there is a margin of safety in results, which is demonstrably larger than model errors. A sensitivity analysis relating to the use of TAPM to generate the meteorological file is presented in Appendix A. This analysis shows that Ausplume outputs utilising TAPM produced meteorological data predict higher TSP concentrations than those achieved using the meteorological data from Paraburdoo Airport. Therefore, we believe that the use of TAPM to generate site specific meteorological data for use in this study is acceptable. We also believe that the use of TAPM generated data is better than using data from Paraburdoo due to the different terrain in the area.

A comparison of the TAPM-generated wind speed and direction and ambient temperatures was made against the closest available meteorological station located approximately 52 km south-east (Paraburdoo Airport) and this is presented as Figures 4 and 5. Predicted wind speeds in Figure 4 show an over prediction of light winds under 3 m/s and an under prediction of winds over 6m/s. Wind direction in Figure 5 shows a over prediction of easterly and north-westerly winds with slight under prediction of north-easterly winds. Comparison of the TAPM-generated wind data with the monitoring data from Paraburdoo in Figure 5 indicates that the modelled data provides a reasonable prediction of the actual wind direction. The TAPM generated meteorological data has a slightly more dominant easterly component, but from a modelled viewpoint is within the range of variability.

The wind roses for the TAPM-generated meteorological data at the HPF site location, representing the seasonal and annual year 2010, are presented as Figure 6. Dominant wind directions are east through to south-east. There is also a proportion of the annual wind from the south-southwest direction. Wind roses for TAPM- generated meteorological data at Paraburdoo Airport are presented as Figure 7. Dominant wind directions are also east through to south-east. There is also a proportion of the annual wind from the south-southeast direction.

Due to local terrain and micro-meteorological effects, the actual wind conditions at any location within the study area may differ to that shown in the Paraburdoo wind roses. However, the broad patterns exhibited in the analysis of the TAPM-generated meteorological data are similar to those exhibited within the local area.

The amount of turbulence in the ambient atmosphere can have a major effect on the dispersion of air pollutants. Ausplume uses the Pasquill Gifford stability classes as the indicator of atmospheric turbulence. A summary of the stability class derived from the meteorological data is presented in Table 4. This shows that neutral conditions (Class D) occur most frequently and that highly unstable conditions (Class A) occur least frequently, which is an expected distribution for this region. Appendix B provides additional detail on the derivation of the meteorological data and its analysis.

Table 4: Pasquill Gifford Stability Class Distribution (%)

A (Very Unstable)	B (Unstable)	C (Slightly Unstable)	D (Neutral)	E (Slightly Stable)	F (Stable)
8%	16%	12%	27%	15%	22%

4.3 Model Setup and Parameterisation

For this study, Ausplume was set up with the following parameters:

- A model domain of 10 km by 10 km, bottom left corner on 525,500 mE and 7,455,250 mN (GDA 94) and 250 m grid spacings
- Dry deposition to model particle settling
- A surface roughness of 0.4 m to simulate the average roughness length over hilly areas.

Each of the potential dust sources described in Section 3.4 has been modelled as either volume or area sources. The initial estimates for plume width and height were assumed to be equal to ¼ of the actual dimensions for each source, and the plume release height was assumed to be close to ½ of the actual height.

A sample Ausplume configuration file used in this assessment is included as Appendix C.

4.4 Discrete Receptors

Dust concentrations were also predicted at discrete receptors within the region as presented in Table 5 and on Figure 8**.**

Table 5: Discrete receptor locations

Description	Easting (m)	Northing (m)
Permanent Village	534500	7461500
Construction Camp	535000	7461500
Nanutarra-Munjina Road	530193	7459944

4.5 Particle Size Distribution

The USEPA's particle size distributions for batch drop, wind erosion and vehicle emissions (USEPA, 2004a, b and c) are presented in Table 6. The distribution data for batch drop and wind erosion are similar, while the particle size distribution for vehicle emissions contains a lower percentage of $PM_{2.5}$. The distribution data for batch drop also indicates that dustiness is proportional to the silt content of the ore. Studies of iron ore dust emissions have indicated that lump ore (with low silt content) can be dustier than some fine ores at the same moisture content (Pitts, 2001) and the batch drop factors are therefore considered unrealistic for iron ore emissions.

In the absence of particle size distribution data for the TSP, PM_{10} and $PM_{2.5}$ fractions specific to the proposed exports, a composite distribution was derived from the USEPA's three emissions categories (Table 6). This distribution is similar to that adopted by SKM (2007) for the air dispersion modelling assessment of fugitive dust emissions associated with the export of bulk products (primarily iron ore) from the Port Hedland port facility. It is noted that adoption of a composite distribution represents a simplification as different particulate emission sources will have different particle size distributions (e.g. wind erosion versus vehicular dust) and there may also be differences in particle size distributions between the different ore types.

Table 6: Particle Size Distributions

<table>
<tr><th rowspan="3">Particle Size Range (µm)</th><th rowspan="3">Representative Particle Size (µm)</th><th colspan="5">Percentage of Particulate (%) in Various Size Ranges</th></tr>
<tr><th rowspan="2">USEPA Batch Drop</th><th rowspan="2">USEPA Wind Erosion</th><th rowspan="2">USEPA Unpaved Road</th><th colspan="2">This Study</th></tr>
<tr><th>TSP</th><th>PM_{10}</th></tr>
<tr><td><2.5</td><td>1.3</td><td>11</td><td>14.8</td><td>3.3</td><td>9</td><td>30</td></tr>
<tr><td>2.5 - 5.0</td><td>3.8</td><td>9</td><td rowspan="3">22.2</td><td rowspan="3">18.7</td><td>8</td><td>27</td></tr>
<tr><td>5.0 - 7.5</td><td>6.3</td><td rowspan="2">15</td><td>7</td><td>23</td></tr>
<tr><td>7.5 – 10</td><td>8.7</td><td>6</td><td>20</td></tr>
<tr><td>10 – 15</td><td>12.5</td><td>13</td><td>7</td><td rowspan="3">52</td><td>14</td><td>-</td></tr>
<tr><td>15 – 23</td><td>19</td><td rowspan="2">26</td><td rowspan="2">30</td><td>15</td><td>-</td></tr>
<tr><td>23 – 30</td><td>26</td><td>15</td><td>-</td></tr>
<tr><td>30 – 40</td><td>35</td><td rowspan="2">26</td><td rowspan="2">26</td><td rowspan="2">26</td><td>15</td><td>-</td></tr>
<tr><td>40 – 50</td><td>45</td><td>11</td><td>-</td></tr>
</table>

Notes

1. Particle sizes are equivalent aerodynamic size and not the physical size. The equivalent aerodynamic size relates to spherical particles with a density of 1 g/cm^3.
2. Wind erosion and vehicle emission size distributions are given for below 30 µm only, but have been adjusted here to less than 50 µm based on assuming 74% of the particulate is less than 30 µm as per the batch drop distribution.
3. The distribution of $PM_{2.5}$ has been modelled assuming a single representative particle size of 1.3 µm.

4.6 Particulate Emission Estimates

To predict dust concentrations in a realistic manner, hourly dust emissions are required from all major sources in the region. Factors that are important for dust generation include:

- the ore type being handled
- moisture content
- operational activities
- quantity of ore being moved and the number of movements
- size of stockpiles and level of activity
- level of vehicle traffic
- rainfall
- evaporation
- ambient wind speed.

The throughput rates, emission factors, control factors and resultant particulate emission estimates for a 15 Mtpa production rate are presented in Table 7. A conservative approach has been adopted in setting emission estimates for stockpiling and reclaiming activities.

The emission factors are primarily based on the default emission rates recommended by the NPI (2011) for 'high' moisture content ores. The control efficiencies adopted for each emission source are based on a combination of the recommended NPI (2011) control factors and the results of dust emissions testing for iron ore stockpiling and material handling as published by Pitts (2001) and described in Section 3.4.

In should be noted that dust emission estimates for fugitive dust sources contain a degree of uncertainty due to the complexity of characterising emission rates and control efficiencies.

Table 7: Emission Factors, Control Factors and Average Particulate Emission Estimates[1]

Source	Tonnage Throughput (Mtpa)	Throughput Rate (tph)	PM_{10} Emission Factor (kg/t)	Control Factor (%)	PM_{10} Emission Estimate (g/s)
Ore Loading to Haul Trucks	15	2,400	0.012	0	2.8
Waste Rock Loading to Haul Trucks	10.3	1,600	0.012	0	1.8
Unloading from Truck to Rom Pad	15	2,400	0.0043	0	2.8
Waste Rock Unloading to Waste Rock Dump	10.3	1,600	0.0043	0	1.8
Loading from Rom Pad to Crusher	15	2,400	0.0043	0	2.8
Primary Crusher	15	2,400	0.004	90	0.26
Secondary Crusher	15	2,400	0.012	90	0.77
Tertiary Crusher	15	2,400	0.012	90	0.77
Screening	15	2,400	-	-	-
Haul Road	15	2,400	-	50	1.8
Transfer Station	15	2,400	0.002	75	0.32
Transfer Station	15	2,400	0.002	75	0.32
Stacking	15	2,400	0.002	75	0.32
Blasting (per blast)	-	-	-	0	92
Drilling	-	-	-	0	0.36
Diesel Power	-	-	-	0	0.08

Table 7: Emission Factors, Control Factors and Average Particulate Emission Estimates[1]

Source	Tonnage Throughput (Mtpa)	Throughput Rate (tph)	PM_{10} Emission Factor (kg/t)	Control Factor (%)	PM_{10} Emission Estimate (g/s)
Station[2]					
FEL Train Loading	15	2,400	0.002	0	1.3
TOTAL					110

References
[1]. Average particulate emission estimates during operations.
[2] Total emissions for all 8 stacks at power station under peak load.

An annual hourly variable emission file for TSP was created for this assessment by multiplying the PM_{10} emissions estimates presented in Table 7 by 3.33 in accordance with the assumed particle size distribution in Table 6 (i.e. PM_{10} is 30% of TSP). The variable emissions file and particle size distribution data were used in the modelling to generate the predicted TSP, PM_{10}, and $PM_{2.5}$ concentrations.

Generation of the hourly variable emission file requires specific hours of the day to be nominated during which emissions from each potential dust source may be released. As detailed scheduling information for the proposed mining site is not available, it was assumed for modelling purposes that operations occur at regular intervals across the whole day. This provides a generally conservative estimate of the potential impacts as all of the sources would not be emitting simultaneously at the site.

4.6.1 Wind Speed Dependence for Material Handling

For all material handling processes exposed to the wind, increasing wind speed acts to increase dust emissions through winnowing of the particles from the falling ore. The USEPA batch drop equations (USEPA, 2004a) specify that the dust emission increases with the wind speed to the power of 1.3. However, as a number of sources in this study are primarily shielded from the wind (such as conveyor transfers), a wind speed exponent of 0.8 was adopted as follows:

$$E_{Actual} = E_{2.2} (WS/2.2)^{0.8}$$

Where:

WS is the wind speed at the drop height;

$E_{2.2}$ is the dust emission given, assumed to be at 2.2 m/s; and

E_{Actual} is the final emission rate.

The average source height was assumed to be 5 m above the surface, with the wind speeds at 10 m reduced to represent wind speeds at 5 m using the 1/7 power law given by:

$$WS_5 = WS_{10} (5/10)^{(1/7)}$$

Where:

WS_5 is the wind speed at a height of 5 m; and

WS_{10} is the wind speed at a height of 10 m.

4.6.2 Wind Erosion

Dust emissions generated by wind erosion are generally negligible below a wind speed threshold, but increase rapidly when wind speeds exceed the threshold. Dust emissions from wind erosion are also dependent on the erodibility of the material, which in turn is dependent on the size distribution of the material and whether a crust has developed. In general, material with a large (>50%) fraction of non erodible particles (generally particles greater than 1 mm to 2 mm) will not erode as the erodible fraction is protected by these particles. As such, lump ores are not erodible by wind erosion though they may be quite dusty during material handling where the small fines fraction can be liberated. Fine ores are generally much more erodible by wind, particularly if they have a large fraction of particles in the range from 0.1 mm to 0.25 mm, which can be dislodged by wind and then rolled and skipped along the surface (saltation). These larger particles, can then dislodge the smaller (<50 µm) dust fraction, which can then remain suspended in the air.

The NPI EETM for Mining specifies a wind erosion factor of 0.2 kg/ha/hr for all sources with the exception of coal stockpiles. However, this factor is considered approximate as it does not take into account variations in the climate of an area or the soil or ore type. Previous studies investigating the impact of dust emissions from other port facilities within the Pilbara region (e.g. SKM, 2003) have used the Shao (2000) equation to parameterise PM_{10} emissions for live stockyards and surrounding roads. Shao (2000) was used to estimate the wind erosion factor for this assessment, as follows:

$$E_{wind} = 5.2 \times 10^{-7} \; WS^{3} \quad (1- (WS_T / WS_{10})^2))$$

Where:

WS_T is the threshold for wind erosion in m/s, taken to be 7.5 m/s (SKM, 2003); and

E_{wind} is the PM_{10} emissions (g/m^2/s).

Based on the TAPM meteorological data generated at the site, the annual average wind speed for the area is 3.0 m/s. The percentage of winds greater than or equal to 7.5m/s at the site is 0.2%.

4.6.3 Rainfall Dependence

To account for the combined effects of rainfall and the activity within the stockpile area, a simple scheme was adopted in the modelling. With regards to wind erosion, rainfall was assumed to not only suppress dust at the time rain was occurring, but to also result in a suppression of dust that gradually decreases over time as surface areas within the stockpile are disturbed or reclaimed and new stockpiles are created. Without stockpile activity, ores such as hematite can form a strong crust and be resistant to wind erosion for extended periods.

Dust emissions were taken to linearly return to an uncontrolled state within 400 hours of the rainfall evaporating if the rainfall event was greater than 25 mm. During the period when it was raining or if the rainfall had not evaporated, emissions were set to zero. The evaporation rate at the surface was assumed to be 1.25 times the amount from a Class A pan with a limit to the amount of water on/near the surface of 75 mm. Class A pan evaporation rates were obtained from monthly averages from the BoM's Paraburdoo Airport monitoring station.

These time scales have been adopted from previous dust assessments (e.g. ENVIRON, 2004) and were originally based on observations of the time taken for high dust levels to return following a large rainfall event at a similar mining facility in the Pilbara region. It is noted that the return to dusty conditions is not just a function of the evaporation of the water, but is determined more importantly from the activity level within the stockpile area, as surfaces are disturbed and fresh surfaces are created as a result of reclaiming, stacking and vehicle movement.

4.7 Diesel Power Station

Emission rates and stack parameters for the on-site power station were provided by API. Under peak usage the power station will run eight generators with a generating capacity of 11MW for 20 hours and two generators for the remaining four hours. Based on a conservative model estimate, the power station has been modelled at its peak load for the entire year. Table 8 lists the stack parameters and emission characteristics as provided by API.

Table 8: Stack Parameters and Emissions

Stack Parameters	
No. of Generators/Stacks	9 (1 Backup)
Diameter	0.45 m
Height	10 m
Temperature	300°C
Velocity	40 m/s
Peak Usage per day	Eight generators running for 20 hours/day followed by two generators for 4 hours
Emission Characteristics per Stack	
Pollutant	**Emission Rate (g/s)**
NO_x	5.15
CO	0.64

Table 8: Stack Parameters and Emissions

SO_2	0.36
TSP	0.03
PM_{10}	0.01

5 Existing Environment

5.1 Climate and Meteorology

The site is located near Paraburdoo Airport in the West Pilbara region of WA, approximately 55 km south-west of Tom Price. The West Pilbara region is classified as having an arid, subtropical climate. The north-west wet season and the formation of low-pressure regions inland influence summer weather, whilst winter weather is dominated by south-easterly air movement, which brings mild conditions.

Temperatures during the summer months are very high due the arid, subtropical climate and have been known to vary up to 8°C above the mean maxima. Conversely, during the winter months, mean minimum temperatures can drop below 10°C and have been known to drop below 0°C.

5.2 Rainfall

The rainfall in the West Pilbara region primarily occurs during the summer months and can be highly variable. This is confirmed in Figure 9**,** which shows the long-term (1975 – 2010) monthly average rainfall. There is a significant difference between the mean rainfall, particularly between the months of December through June. This difference is primarily due to the impact of tropical depressions. The seasonal variation in rainfall may lead to a higher level of particulate emissions from the mining activities during the winter months due to the reduced natural mitigation that precipitation provides. The same effect may be seen with ambient natural background levels of particulates as this is known to be a highly dusty region.

5.3 Wind Direction and Speed

The seasonal wind roses presented in Figure 10 were derived from data recorded at the Paraburdoo Airport station. Wind direction during the summer period is shown to be variable, with westerly and north easterly winds the most dominant.

Annual wind roses for the Paraburdoo region, for the period 2007 to 2010, are presented as Figures 11 to 14. Dominant winds are northeast to east-southeast. There is also a reasonable proportion of westerly wind, but not as predominant as the north easterly winds.

5.4 Existing Air Quality

The mining site is in a remote location with scattered mining operations throughout the region. Natural sources of particulate matter from wind erosion in an arid, dusty region contribute to high ambient levels of dust. An aggregate emission study of particulate matter in the Pilbara region of WA was undertaken by SKM in 2000 (SKM, 2003). The study found that the Pilbara region emitted around 170 million kilograms of windblown particulate matter in the 1998/99 financial year.

Given the high background levels of dust in the region, uniform background concentrations for PM_{10} and TSP were assumed for this assessment. Annual average background levels of 25 ug/m^3 and 50 ug/m^3 for PM_{10} and TSP were used for the region as derived in the SKM study in 2000 (SKM 2003). Time resolved background concentration data were not available and therefore the modeling only considered the HPF in isolation.

6 Modelling Results

6.1 Predicted Ambient Particulate Concentrations

A summary of the off-site TSP, PM_{10} and $PM_{2.5}$ concentrations predicted for the proposed HPF (including the mine) are presented in Table 9.

Table 9: Summary of Predicted TSP, PM_{10} and $PM_{2.5}$ GLCs – 15 Mtpa

Particulate Fraction	Averaging Period	Standard (µg/m³)	Background Concentration (µg/m³)	Predicted Concentration (µg/m³)		
				Village	Camp Site	Nanutarra-Munjina Road
TSP	24-hour	90	-	41	41	859
	Annual	NA	-	4	3	44
	Annual	NA	50	54	53	94
PM_{10}	24-hour	50	-	13	12	271
	Annual	NA	-	1	1	13
	Annual	NA	25	26	26	38
$PM_{2.5}$	24-hour	25	-	4.0	3.9	58
	Annual	8	-	0.4	0.3	7.4

Notes
1. Maximum predicted 24-hour GLCs and annual average GLCs presented.
2. Background concentration based on aggregate emission study of particulate matter in the Pilbara region of WA was undertaken by SKM in 2000 (SKM 2003). Time resolved background concentration not available and thus excluded from 24-hour results.

Contours of the maximum predicted 24-hour average TSP concentrations (Figure 15) indicate that exceedances of the Kwinana EPP Area B 24-hour TSP standard are predicted to occur over a distance of up to approximately 4 km from the mining operations. However, at the receptors of Village and Camp Site the maximum predicted 24-hour TSP GLCs are below the 24-hour TSP standard. The receptor on Nanutarra-Munjina Road is predicted to experience TSP concentrations well in excess of the 24-hour TSP standard. Contours of the predicted annual average TSP concentrations (Figure 16) illustrate a similar pattern of distribution, where peak concentrations are localised to operations.

Contours of the maximum predicted 24-hour average PM_{10} concentrations (Figure 17) indicate that exceedances of the 24-hour PM_{10} NEPM standard are predicted to occur over a distance of up to approximately 3 km from API's operations. The maximum 24-hour average PM_{10} GLCs predicted at the Village, Camp site and Nanutarra-Munjina Road receptors are equal to 26%, 24% and 542% of the 24-hour PM_{10} NEPM standard, respectively. Contours of the predicted annual average PM_{10} concentrations illustrate a similar pattern of distribution to those for TSP (Figure 18).

Contours of the maximum predicted 24-hour average $PM_{2.5}$ concentrations (Figure 19) indicate that exceedances of the NEPM short-term $PM_{2.5}$ advisory reporting standard are predicted to occur within approximately 1 km of the site. The maximum 24-hour $PM_{2.5}$ GLCs predicted at the receptors of Village, Camp Site and Nanutarra-Munjina Road are 16%, 15% and 232% of the 24-hour $PM_{2.5}$ advisory reporting standard respectively. Contours of the annual average $PM_{2.5}$ concentrations (Figure 20) indicate that exceedances of the annual $PM_{2.5}$ advisory reporting standard are localised to the HPF and is not exceeded at the nominated receptors. At Village and Camp Site the predicted annual $PM_{2.5}$ concentrations are less than 9% of the guideline value.

The TSP, PM_{10} and $PM_{2.5}$ concentrations predicted at the Village and Camp Site receptors are below the nominated guidelines. However, exceedances of the guidelines are predicted to occur at the Nanutarra-Munjina Road receptor due to the close proximity of this receptor to the emission sources at the mine site.

Analysis of the source contribution to predicted GLCs indicates that the maximum predicted TSP and PM_{10} GLCs are primarily driven by fugitive emissions from the use of the front end loaders for during the loading of the trains and stockpiling activities. Consideration of additional dust control measures at the proposed HPF targeting these sources may be required to ensure ambient air quality guidelines are met. Recommendations towards ongoing dust management are presented in Section 7.

6.2 Predicted Deposition Rates

A summary of the monthly average TSP deposition rates predicted for HPF operating at 15 Mtpa and a comparison of these rates to the NSW OEH dust deposition criteria is presented in Table 10. Contours of the monthly average TSP deposition rates are presented as Figure 21.

Table 10: Summary of Predicted TSP Deposition Rates[1] – 15 Mtpa

Particulate Fraction	Dust Deposition Criteria (g/m^2/month)	Maximum Predicted Deposition Rate (g/m^2/month)		
		Village	Camp Site	Nanutarra-Munjina Road
TSP	2 (increase)[2]	1.9	1.8	59.4
	4 (total)[3]			

Notes
1. Maximum deposition rate predicted offsite.
2. Maximum increase in deposited dust level.
3. Maximum total deposited dust level.

Contours of the deposition rates predicted for API's proposed facility indicate that deposition rates in excess of 4 g/m^2 are expected to occur over a distance of approximately 3 km from API's operations. The deposition rates predicted at the Village and Camp Site receptors are below the NSW OEH guideline values. However, the receptor at Nanutarra-Munjina Road is predicted to experience total dust deposition well above these guidelines.

The annual average dust deposition rate indicates that additional dust control measures, such as those outlined in Section 7, may be required to ensure compliance with the deposition guidelines off-site.

6.3 Predicted Ambient Gaseous Pollutant Concentrations

A summary of the CO, SO_2 and NO_2 concentrations predicted for the HPF power station and a comparison of these concentrations to the NEPM criteria are presented in Table 11. Contours of the predicted concentrations for each of these pollutants are presented as Figures 22 to 27.

Table 11: Summary of Predicted CO, SO_2 and NO_2 Concentrations

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Predicted GLC[1] ($\mu g/m^3$)		
			Village Pad	Camp Pad	Nanutarra-Munjina Road
CO	8 Hours	10000	16.5	11.8	266
NO_2	1 hour	246	84	79	383
	1 year	62	10	8	58
SO_2	1 hour	572	18	14	247
	24-hour	228	4.4	4.2	86
	Annual	57	0.5	0.4	10

Notes
[1]. Maximum predicted 24-hour GLCs and annual average GLCs presented.

Contours of the CO and SO_2 concentrations predicted for the proposed power station indicate that the NEPM criteria are not exceeded at any of the receptors. The NO_2 1-hour concentrations predicted at the receptors of Village and Camp Site are 84 $\mu g/m^3$ and 79 $\mu g/m^3$ respectively, which is approximately 34% of the NEPM standard of 246 $\mu g/m^3$. The maximum 1-hour NO_2 concentration predicted for the Nanutarra- Munjina Road site exceed the NEPM criteria of 246 $\mu g/m^3$. There were 147 hours in the year (1.7%) modelled where the predicted 1-hour NO_2 concentration for Nanutarra- Munjina Road site exceeded the guideline. This is attributed to the proximity of the Nanutarra- Munjina Road receptor to the power station and the relatively high emission rates from the power station. This is in relation to The Protection of the Environment Operations (Clean Air) Regulation 2010, Schedule 4, (NSW) classifying any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of less than 10 MW having a rate of emission of no greater than 70 mg/m^3.

Modelling is based on conservative estimates and assumes all the power station generators will be in operation at peak load throughout the entire year. NO_2 concentrations were predicted using the USEPA's Ozone-Limiting Method (OLM) based on an average 1-hour O_3 of 25 ppb (recorded at Dampier from the Monitoring of Ambient Air Quality and Meteorology during the Pilbara Air Quality Study by the Department of Environmental Protection (2002)) and an initial NO_2/NO_x ratio of 10% in the emissions.

7 Recommendations

The air dispersion modelling results indicated that careful dust management strategies will be required to demonstrate that the PM_{10} NEPM criteria is met during the operation of the proposed HPF and mine. As part of the dust management for this project it is recommended that further investigation into the practicality of introducing the following dust reduction strategies is undertaken.

- Train Loading
  - Alternatives to FELs such as swing loaders
  - Spray curtain at train loading site
  - Wind Screen Systems can be used to lower wind velocities thus reducing the amount of airborne particulate from material stockpiles, or loader dump pockets
  - Dry Fog systems utilize compressed air and plain water to produce a very dry fog (1-10 micron droplet size). These ultra-fine water droplets attach (agglomerate) to like size dust particles. The slightly wetted dust particles are then heavy enough to be removed from the air by their added weight and fall back into the process.
- Wind erosion:
  - minimise the extent of land cleared
  - minimise the size of active open areas
  - examine the potential of mulching or hydromulching inactive areas
  - install wind erosion fences to reduce the fetch length and wind speed
  - use chemical binding agents with water for suppression
  - prevent vehicle access to inactive areas.
- Vehicle movements and train loading:
  - reduce vehicle speeds
  - reduce frequency of trips on dry unsealed roads
  - install cattle grids between dusty and non-dusty areas
  - install bollards to prevent vehicles leaving designated roads
  - consider the use of chemical binding agents in water used for suppression (mine to port applications – being investigated by other iron ore companies)
  - Overburden dumping in sheltered areas during high winds
  - Load profiling and chemical veneering of loads on rail wagons
  - Train loading in an enclosed area – potentially vented to abatement device

  - Use of cameras to aid visual inspections for early identification of emissions.

- NO_2 Emissions
  - Increase stacks heights to reduce emissions at discrete receptors.

The installation and operation of a dust monitoring network should also be investigated. Such a network may comprise a series of light scattering monitors, such as the MetOne E-Sampler fitted with wind speed and wind direction sensors. The monitoring network could be integrated into the dust management alarm framework such that key personnel would be automatically notified when certain dust concentrations have been exceeded (as recorded at the monitors), allowing corrective action to be implemented in a timely manner. In addition, BoM forecast data could be used to identify high wind days.

8 Conclusions

Air dispersion modelling has been completed to assess the potential impact on ambient air quality of fugitive dust emissions associated with operations at the proposed HPF operating at a capacity of 15 Mtpa. Ambient GLCs of TSP, PM_{10} and $PM_{2.5}$ and particulate deposition rates have been predicted using air dispersion modelling.

The maximum predicted 24-hour average off-site concentrations of TSP, PM_{10} and $PM_{2.5}$ are expected to exceed the corresponding ambient air quality guidelines over an area of up to 3 km from the HPF. The maximum predicted 24-hour average concentrations of TSP, PM_{10} and $PM_{2.5}$ are predicted to be well below the guideline values at the Village and Camp Site receptors. Exceedances of the 24-hour average standards for TSP, PM_{10} and $PM_{2.5}$ are predicted for the Nanutarra-Munjina Road receptor primarily due to the close proximity of the receptor to mine dust sources (less than 100 m).

The predicted annual average $PM_{2.5}$ concentrations at the Village and Camp Site are less than 9% of the applicable guideline value. At Nanutarra-Munjina Road the predicted annual average represents 93% of the applicable guideline value.

Exceedences of the NSW OEH incremental dust deposition criterion are predicted to occur for distances of up to approximately 2 km from the proposed HPF. However, the predicted annual average deposition rates at the receptors of the Village and Camp Site remain below both the NSW OEH's cumulative deposition criterion of 4 g/m^2/month and the incremental deposition criterion of 2 g/m^2/month. The predicted annual average deposition rates at the Nanutarra-Munjina Road receptor exceeds the incremental and total deposition criteria of 2 g/m^2/month and 4 g/m^2/month respectively due to its close proximity to the HPF.

Analysis of the source contribution to predicted GLCs indicates that the predicted TSP, PM_{10} and $PM_{2.5}$ GLCs are dominated by fugitive emissions from the front end loaders used to EL load the trains. Consideration of additional dust control measures or alternative loading mechanisms at the HPF targeting this emission sources may be required to reduce dust emissions.

The modelling of the emissions from the HPF power station indicate that CO and SO_2 concentrations predicted for the proposed power station are well below the NEPM criteria at all of the modelled receptors. The maximum predicted 1-hour average NO_2 concentration at the Nanutarra- Munjina Road receptor exceeds the NEPM criteria. This is attributed to the proximity of the Nanutarra- Munjina Road receptor to the power station and the relatively high emission rates from the power station in relation to The Protection of the Environment Operations (Clean Air) Regulation 2010, Schedule 4 (NSW).

In considering these results, it should also be noted that the prediction of ambient dust concentrations from fugitive sources by air dispersion modelling is difficult primarily due to the complexity and uncertainty in estimating dust emissions. Modelling results have a degree of inherent uncertainty and proponents should focus on management measures to control and reduce dust emissions from the proposed facility.

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10 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to API Management Pty Ltd dated 14 March 2011 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent ENVIRON's professional judgement 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 the assessment.

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.

10.1 User Reliance

This report has been prepared exclusively for API Management Pty Ltd and may not be relied upon by any other person or entity without ENVIRON's express written permission.

Figures

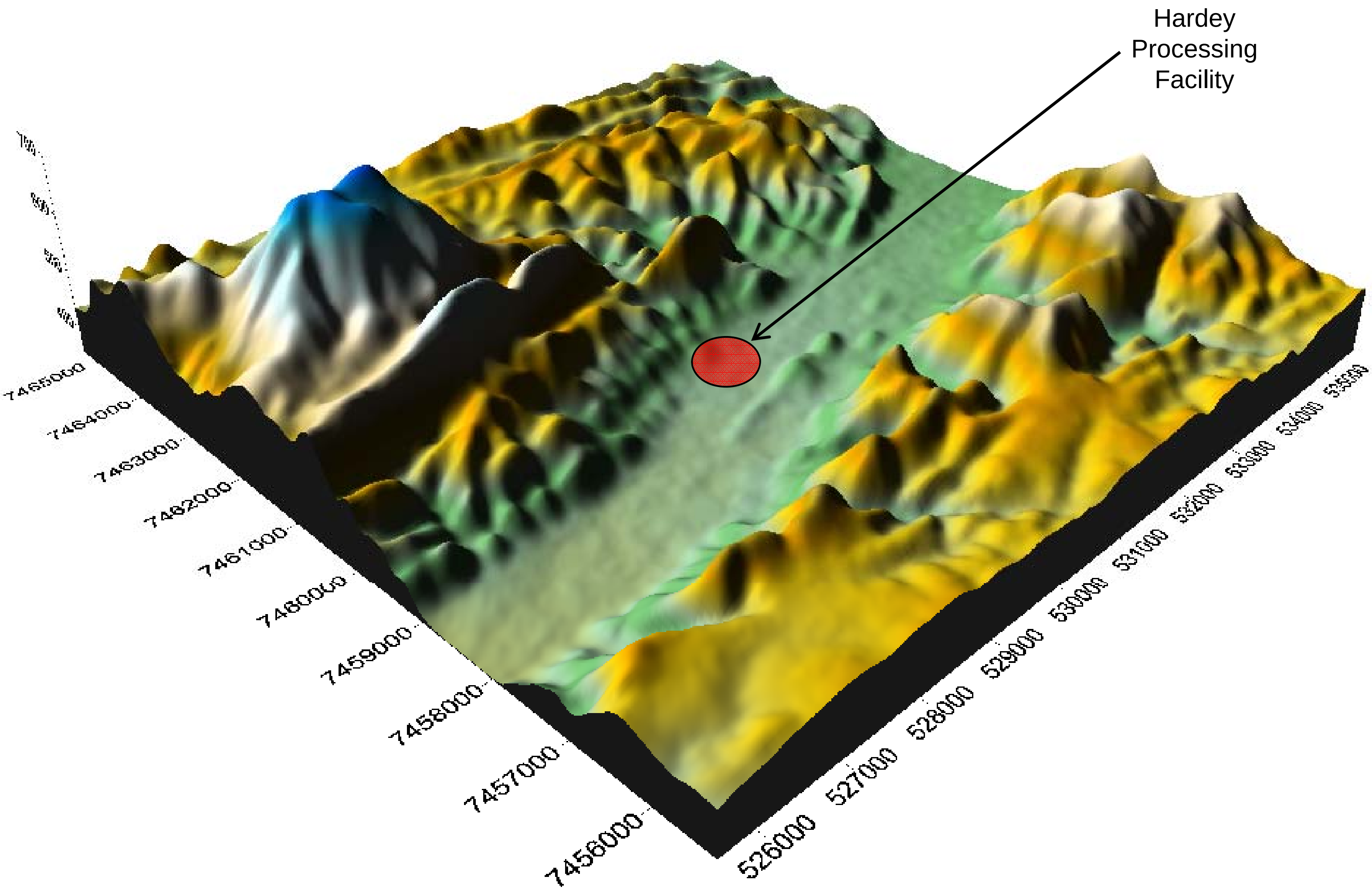


Figure 1: Geographical Map of the Area

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

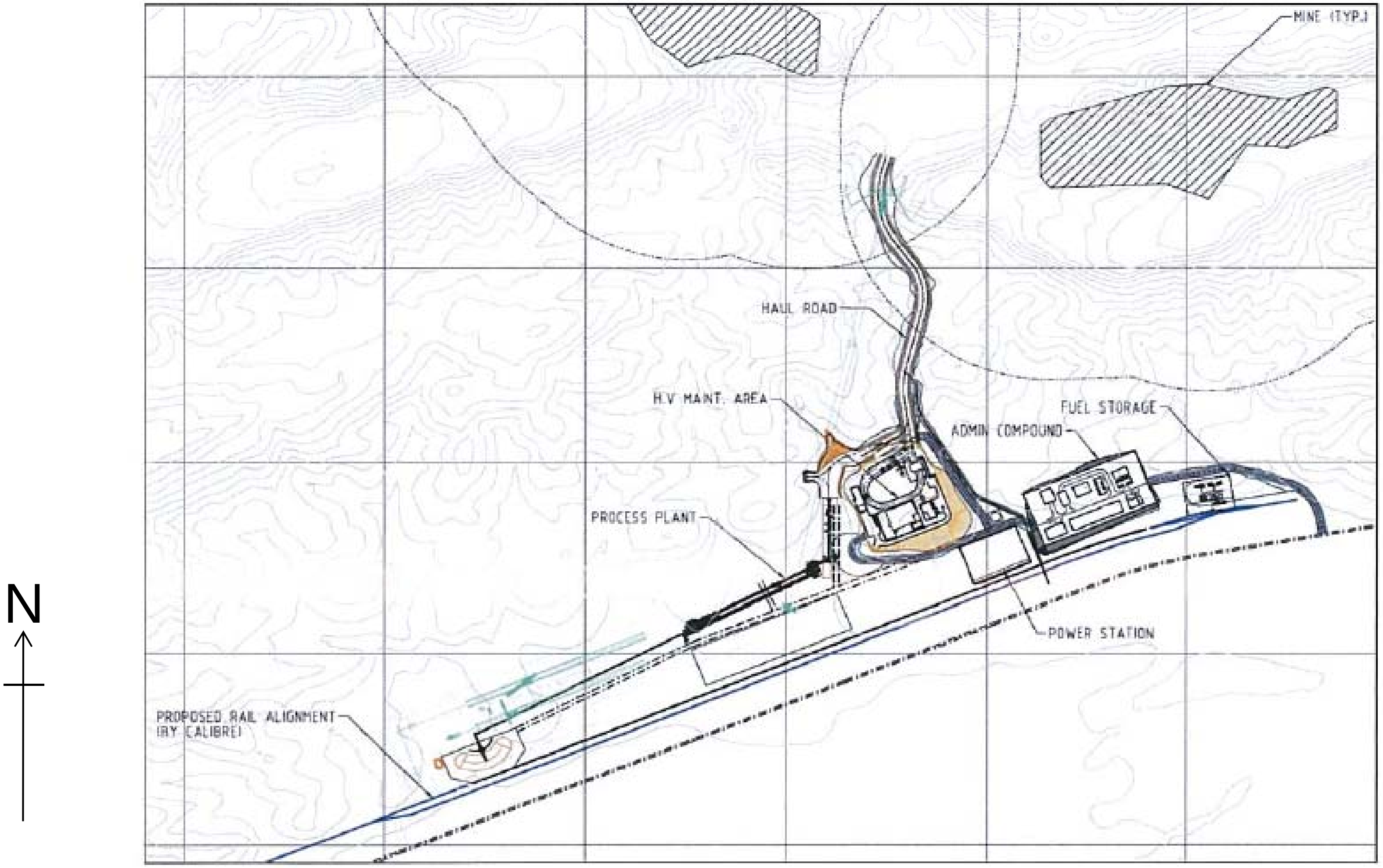


Figure 2: API Proposed Facility

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

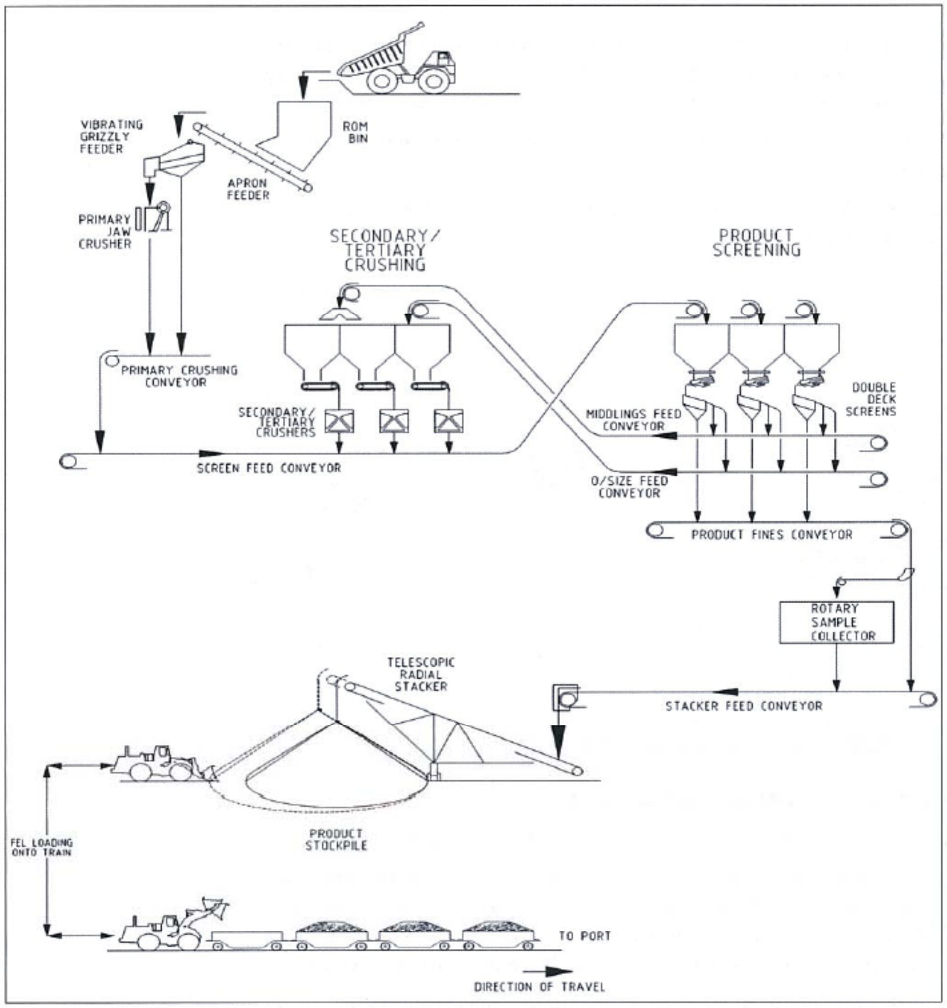


Figure 3: Process Flow Diagram

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

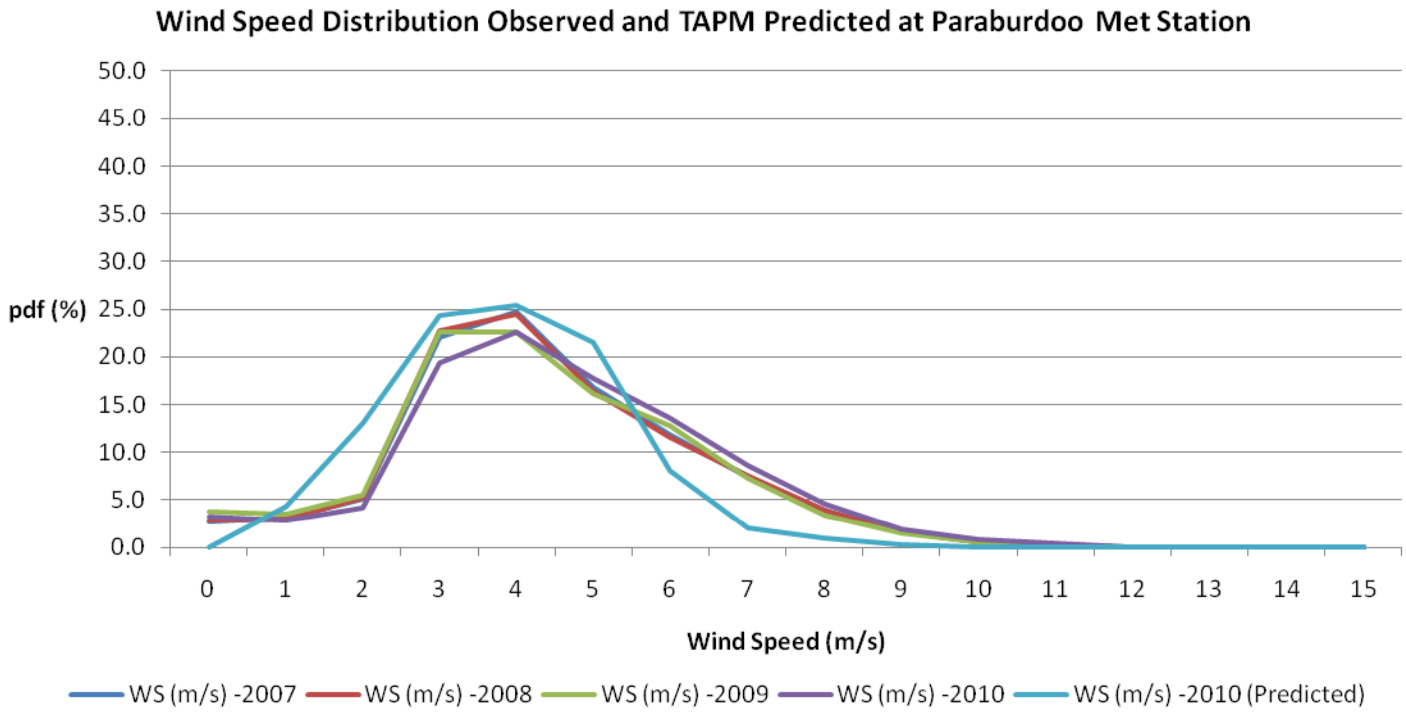


Figure 4: Comparison of Wind Speed Observed and Predicted at Paraburdoo Met Station

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

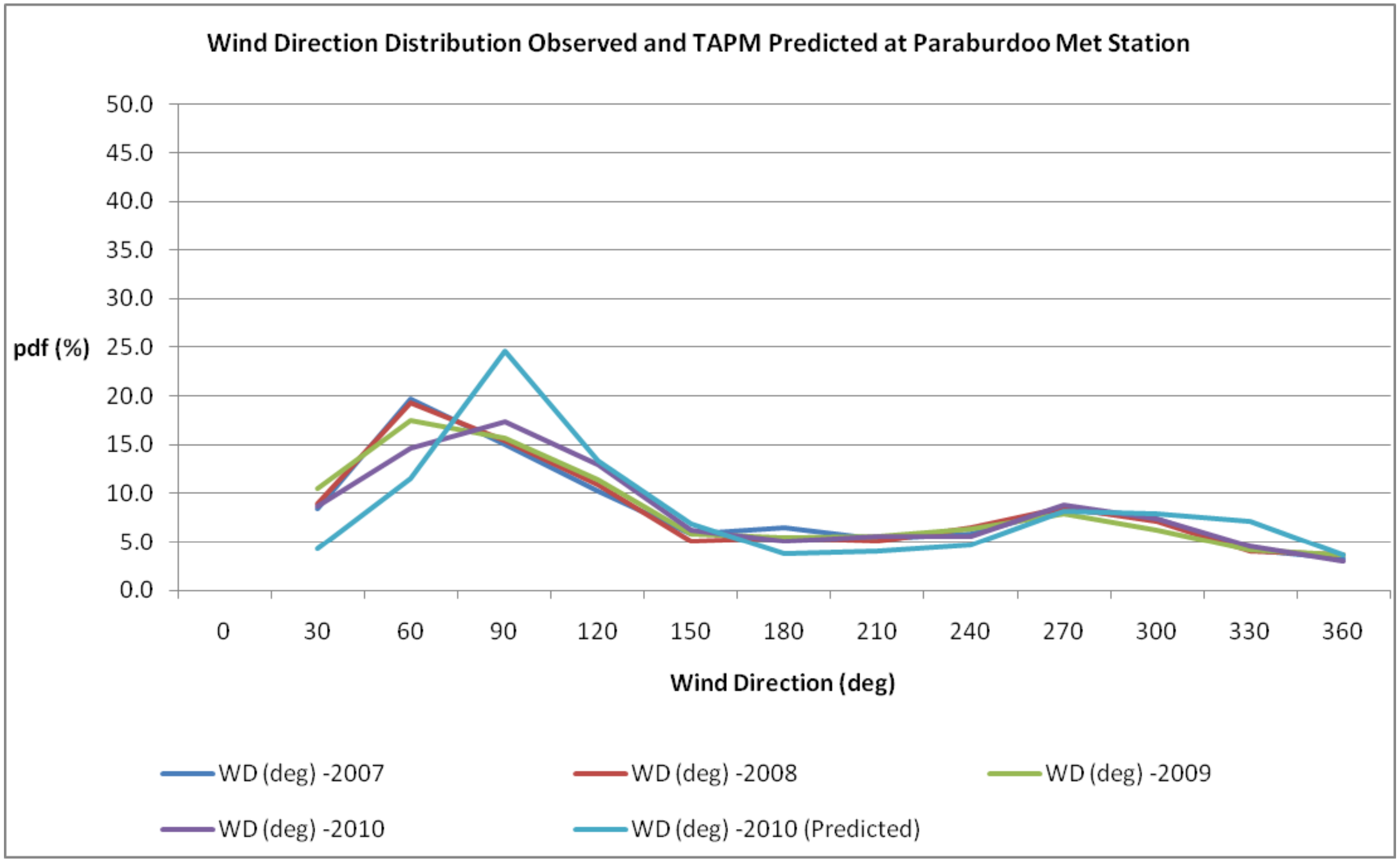


Figure 5: Comparison of Wind Direction Observed and Predicted at Paraburdoo Met Station

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

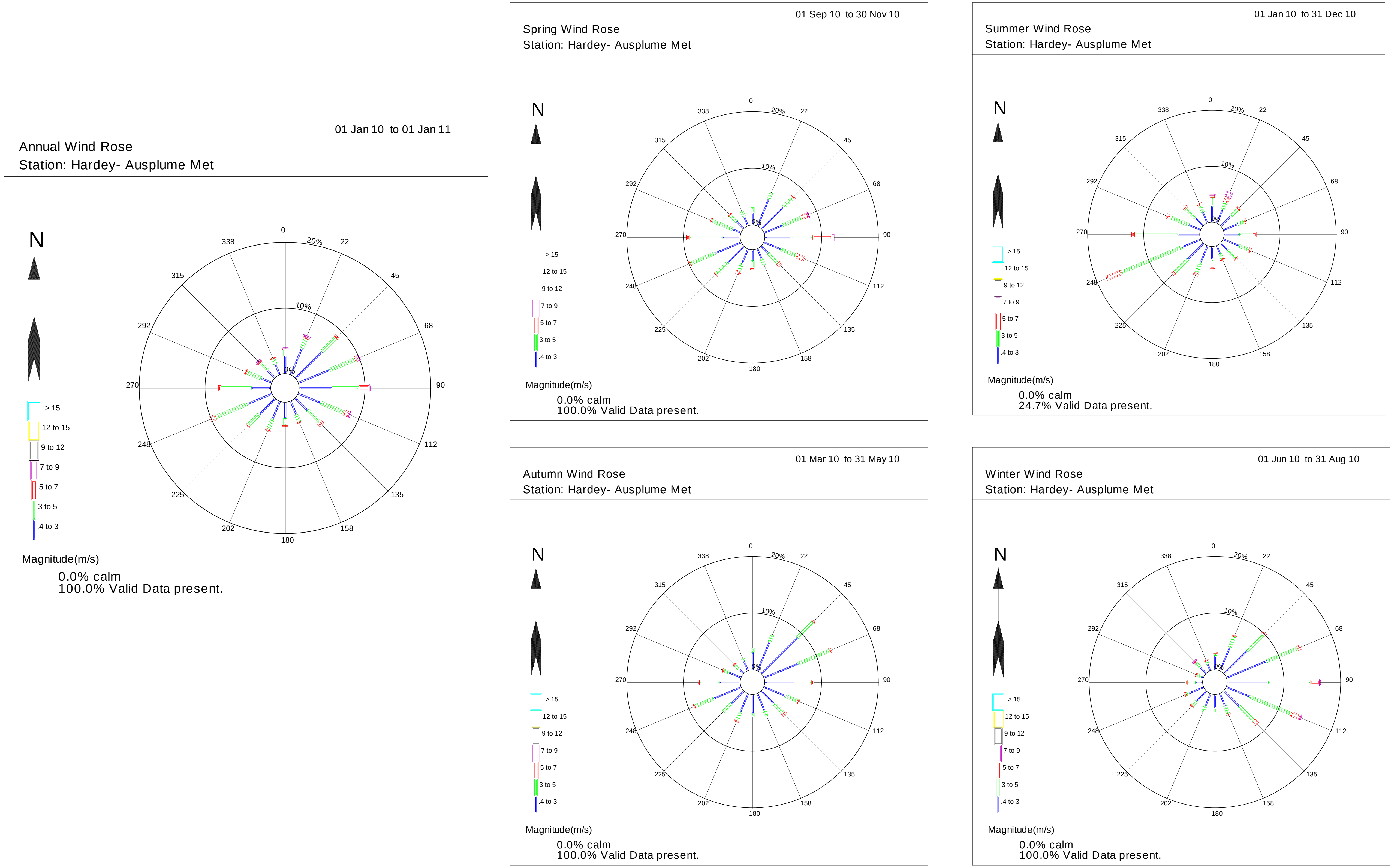


Figure 6: Predicted Winds at HPF – Wind Rose Annual and Seasonal for 2010

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

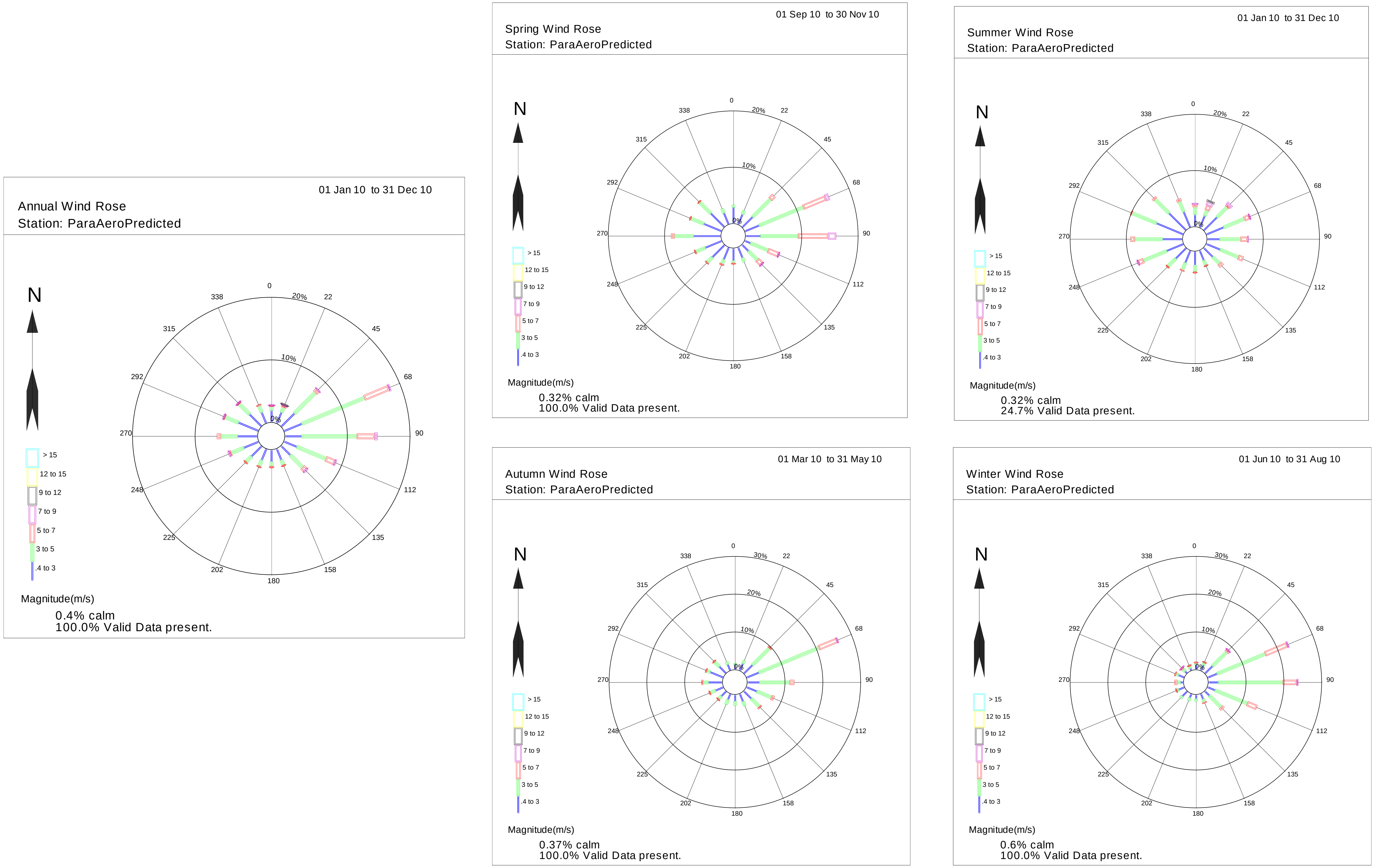


Figure 7: Predicted Winds at Paraburdoo Airport – Wind Rose Annual and Seasonal for 2010

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

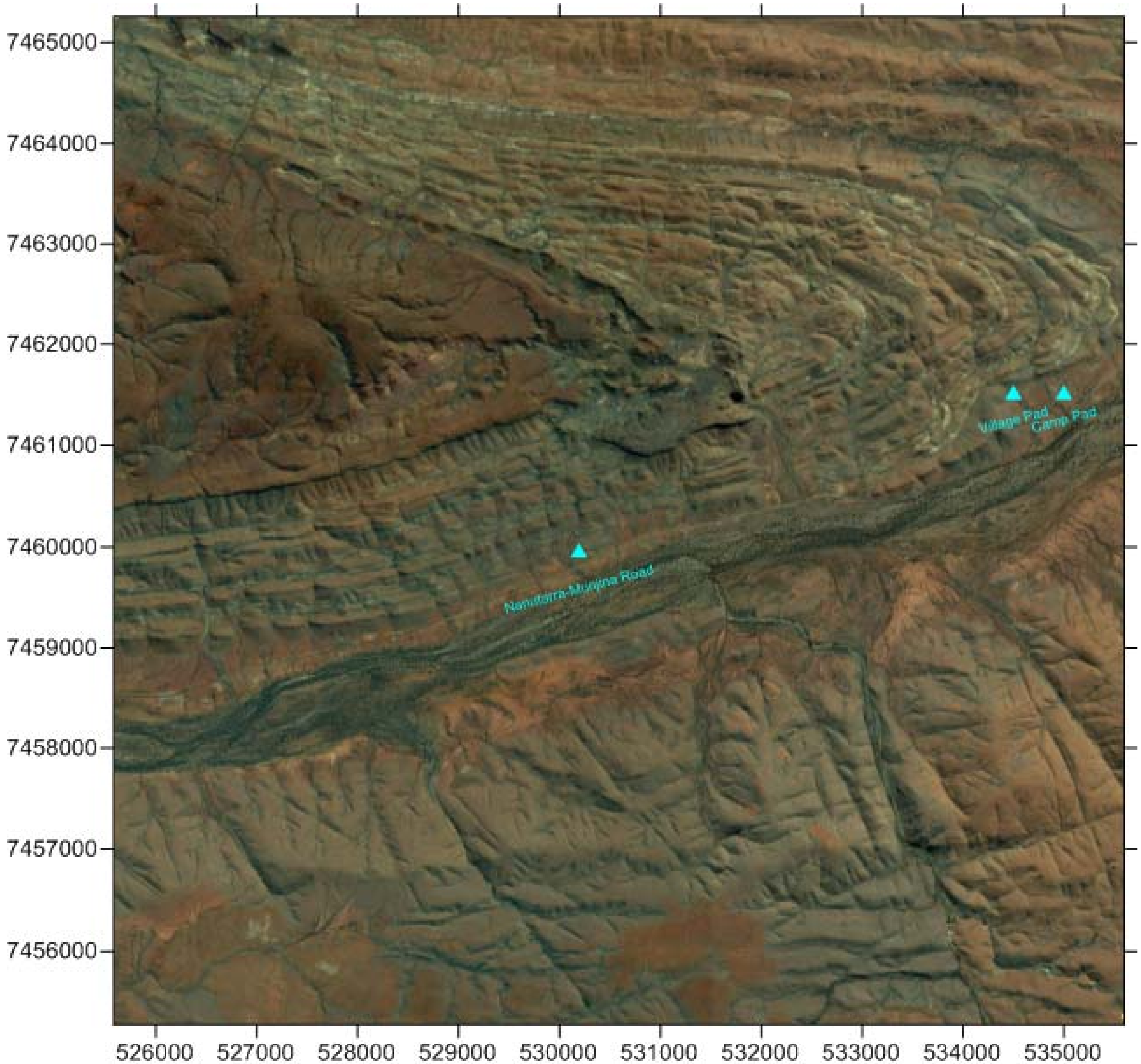


Figure 8: Location of Discrete Receptors

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

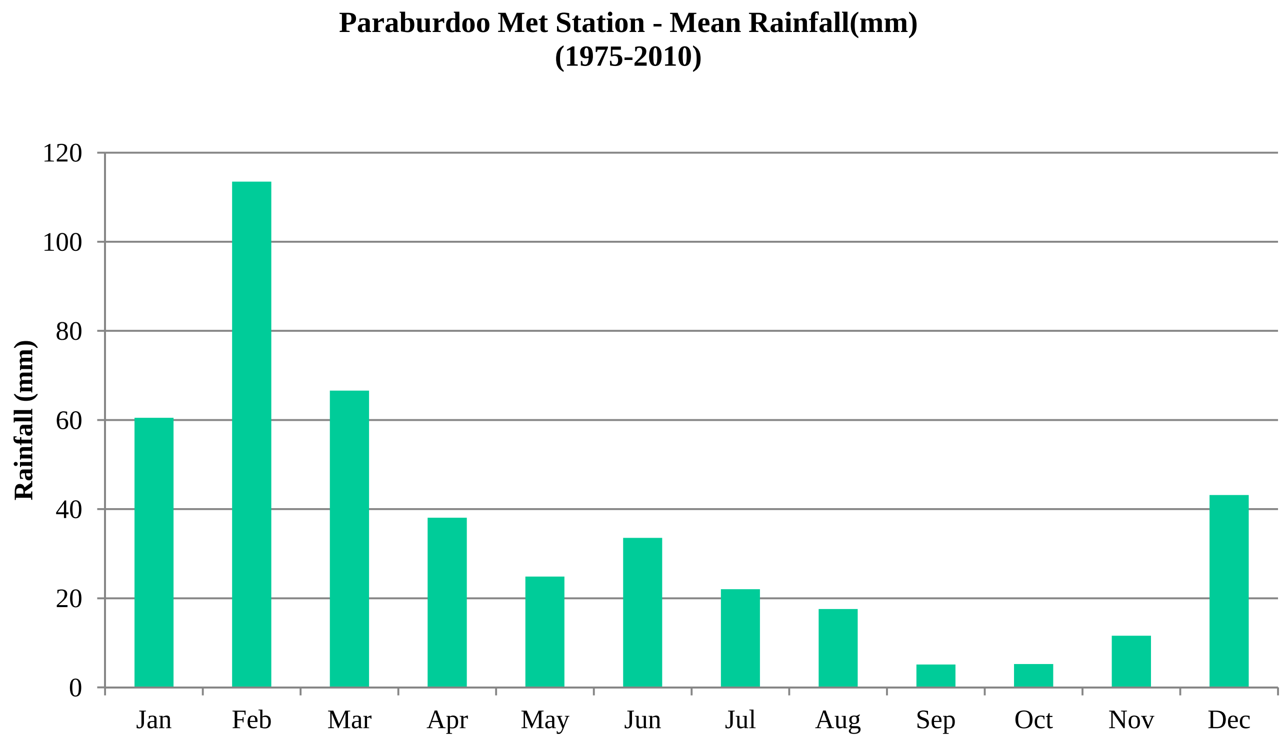


Figure 9: Mean Rainfall (1975-2010)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

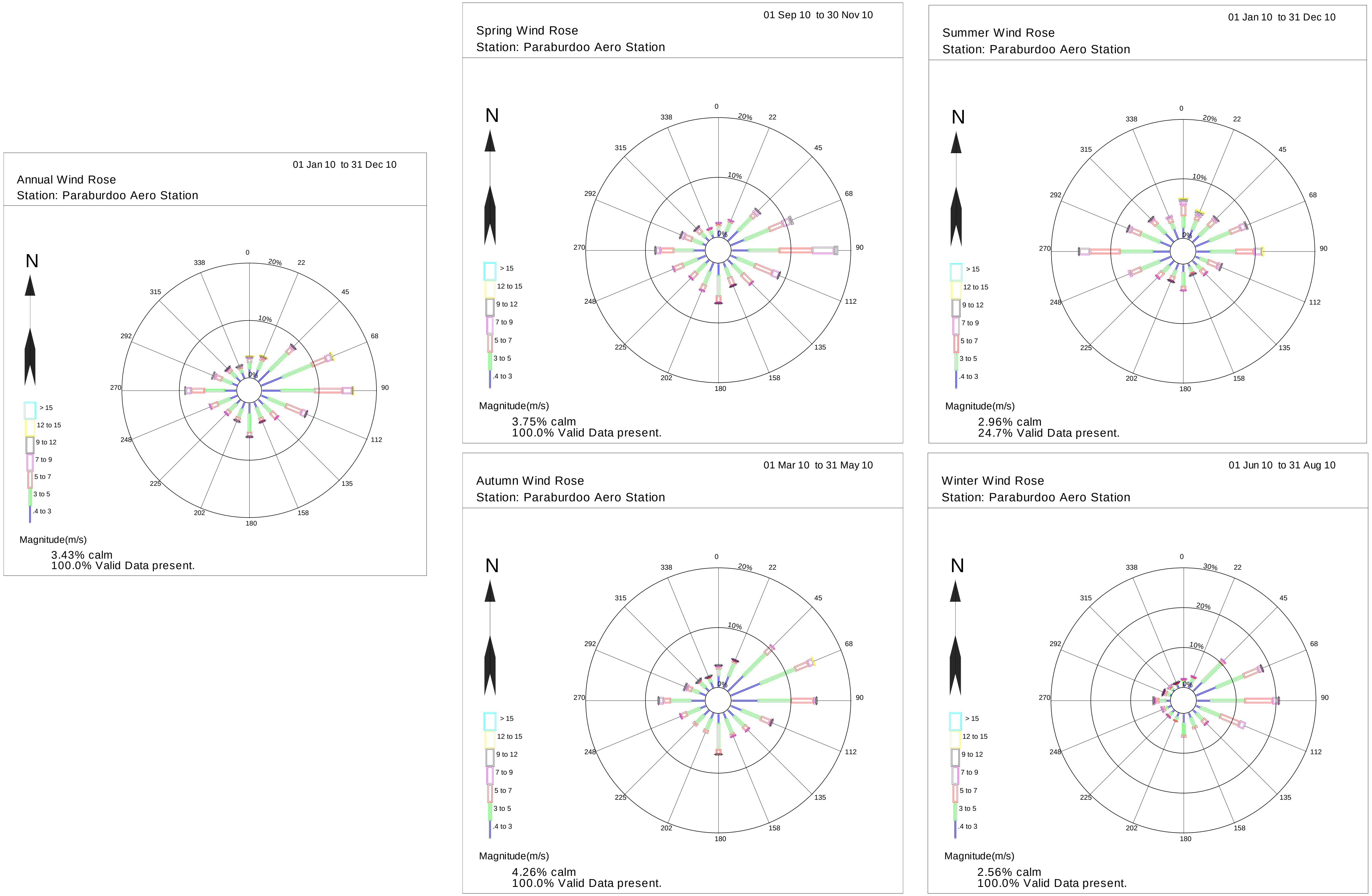


Figure 10: Observed Winds at Paraburdoo Airport – Wind Rose Annual and Seasonal for 2010

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

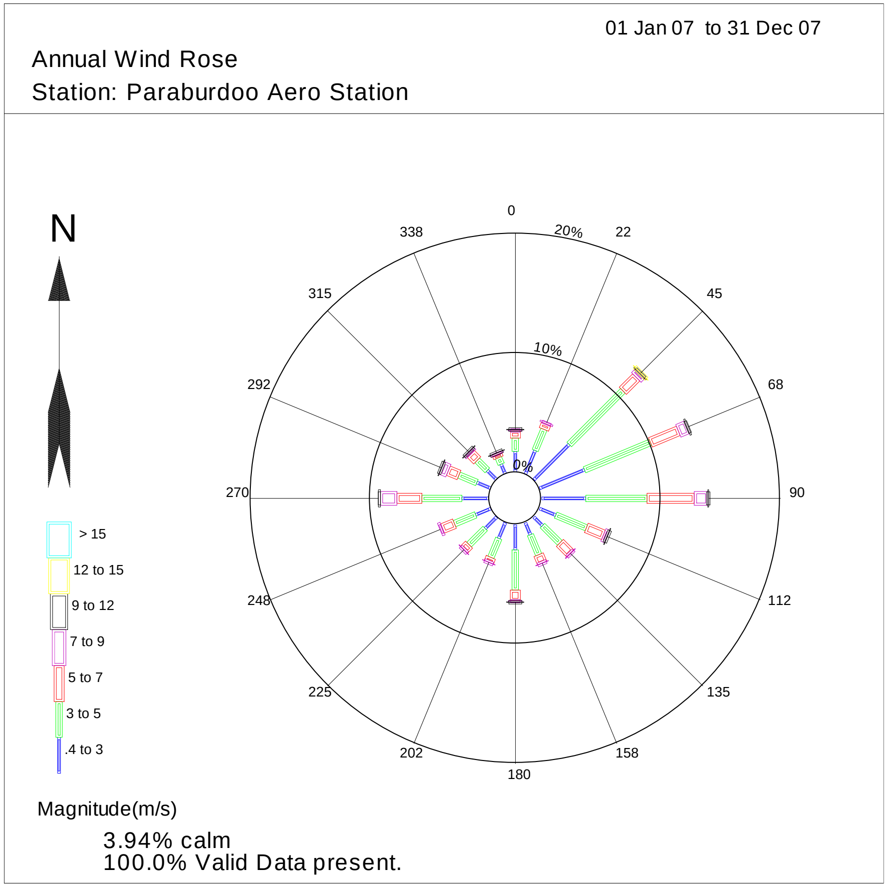


Figure 11: Observed Meteorological - Wind Rose - Annual 2007

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

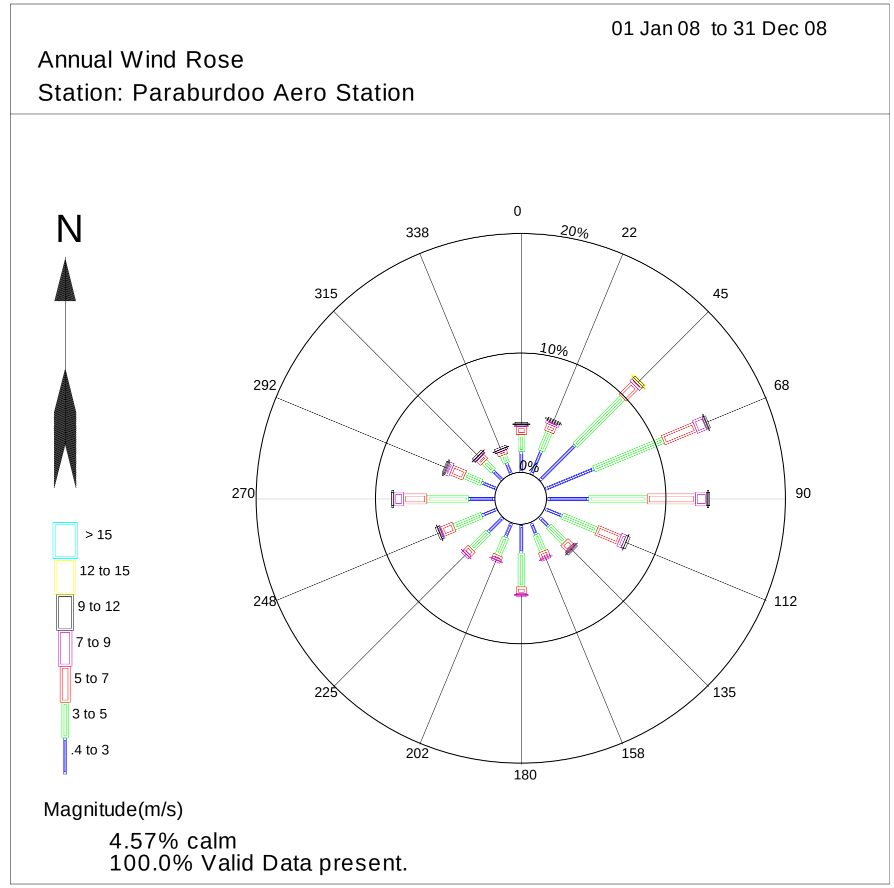
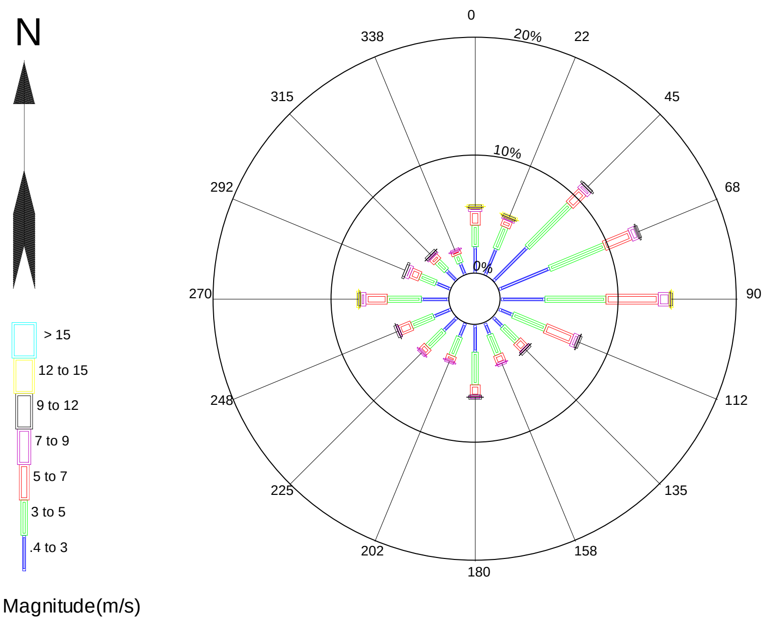


Figure 12: Observed Meteorological - Wind Rose - Annual 2008

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

01 Jan 09 to 31 Dec 09

Annual Wind Rose
Station: Paraburdoo Aero Station



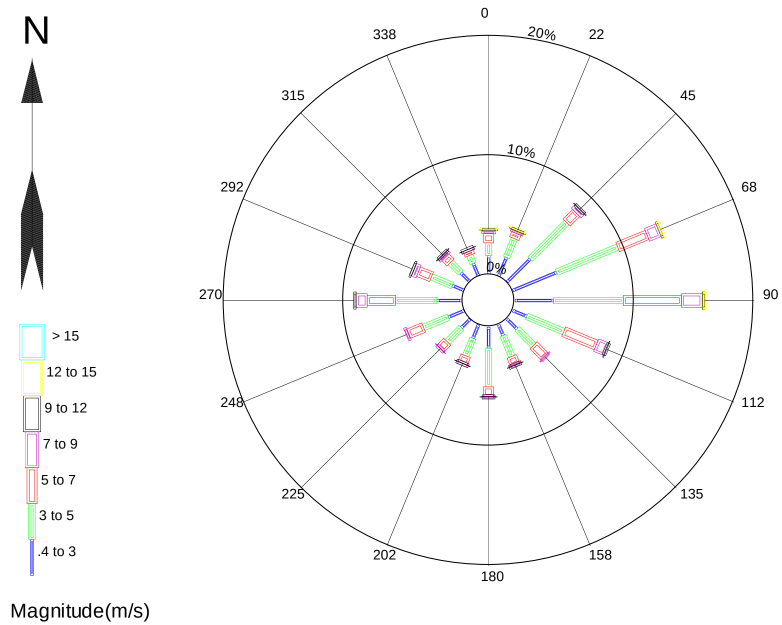
4.29% calm
100.0% Valid Data present.

Figure 13: Observed Meteorological - Wind Rose - Annual 2009

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

01 Jan 10 to 31 Dec 10

Annual Wind Rose
Station: Paraburdoo Aero Station



3.43% calm
100.0% Valid Data present.

Figure 14: Observed Meteorological - Wind Rose - Annual 2010

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

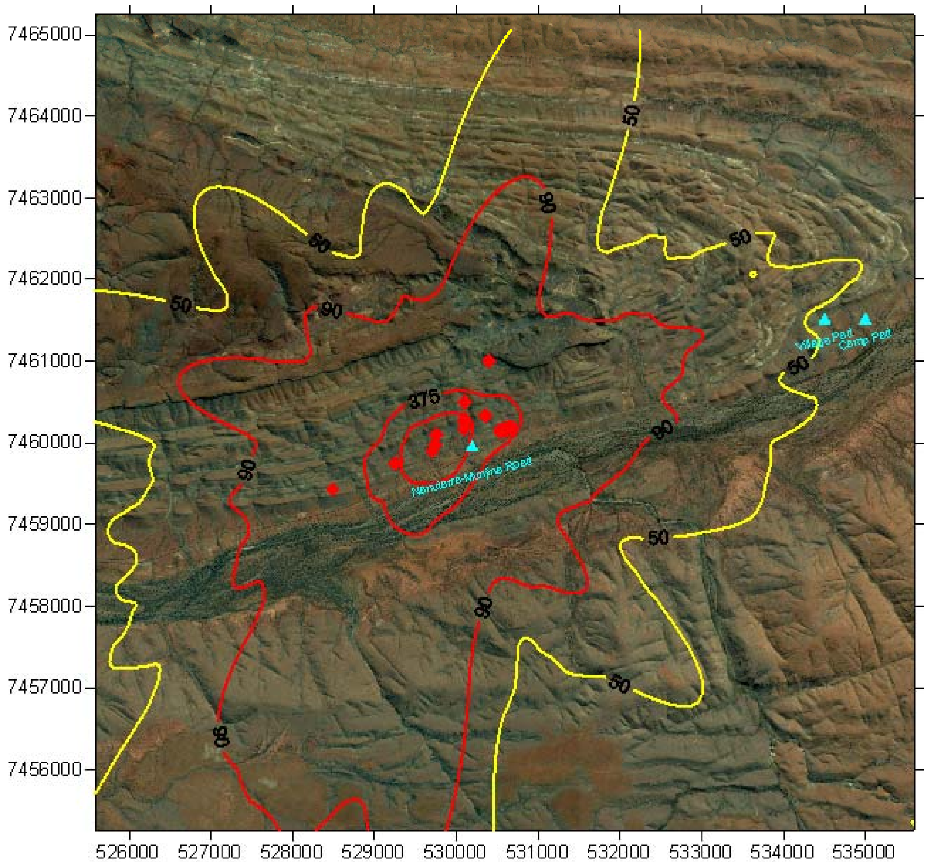


Figure 15: Predicted Ground Level Concentrations of TSP – 24 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

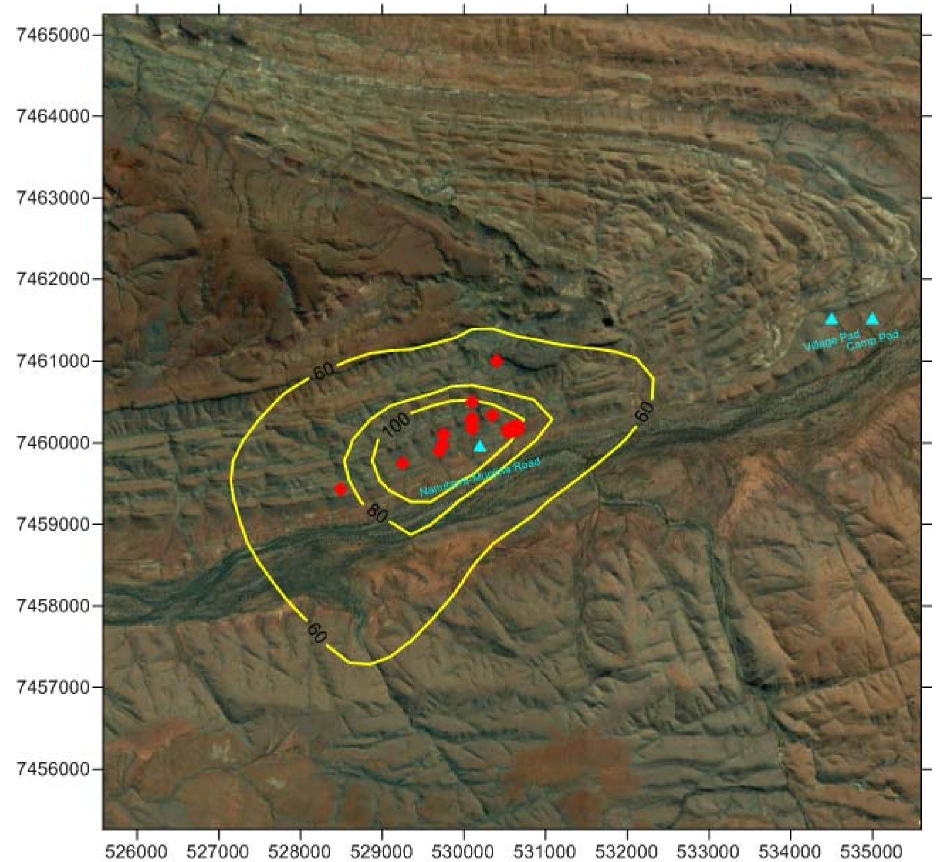


Figure 16: Predicted Ground Level Concentrations of TSP + Background Concentration - Annual Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

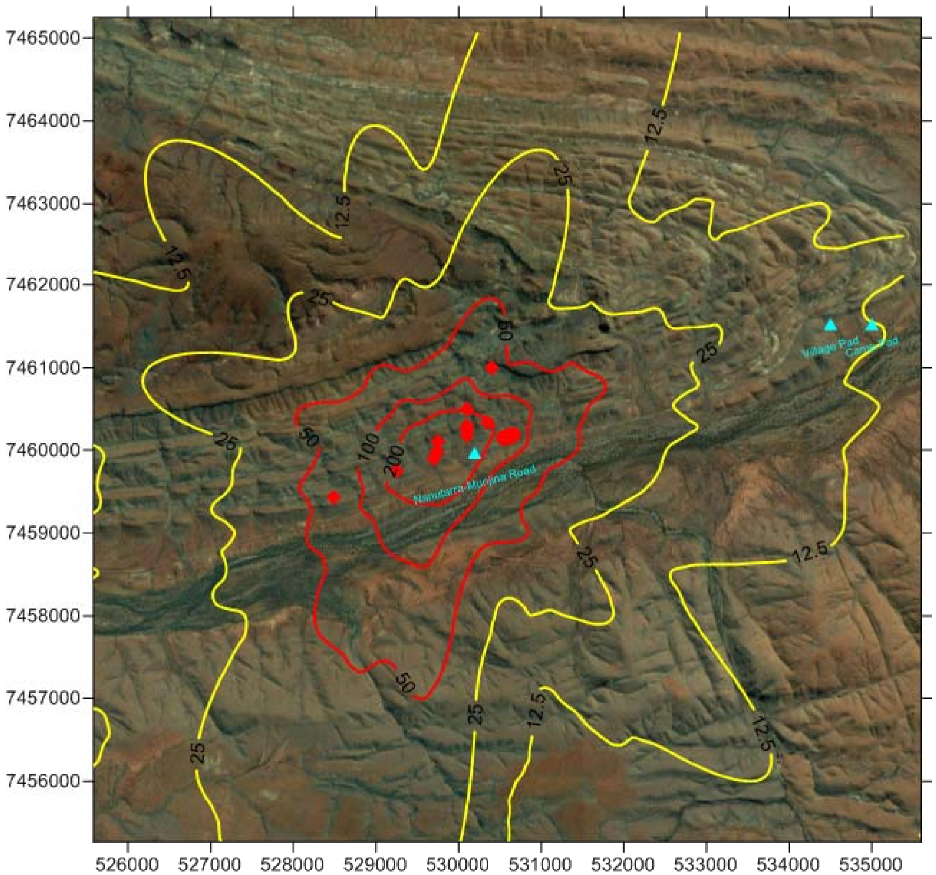


Figure 17: Predicted Ground Level Concentrations of PM_{10} 24 Hour Average (μg/m3)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

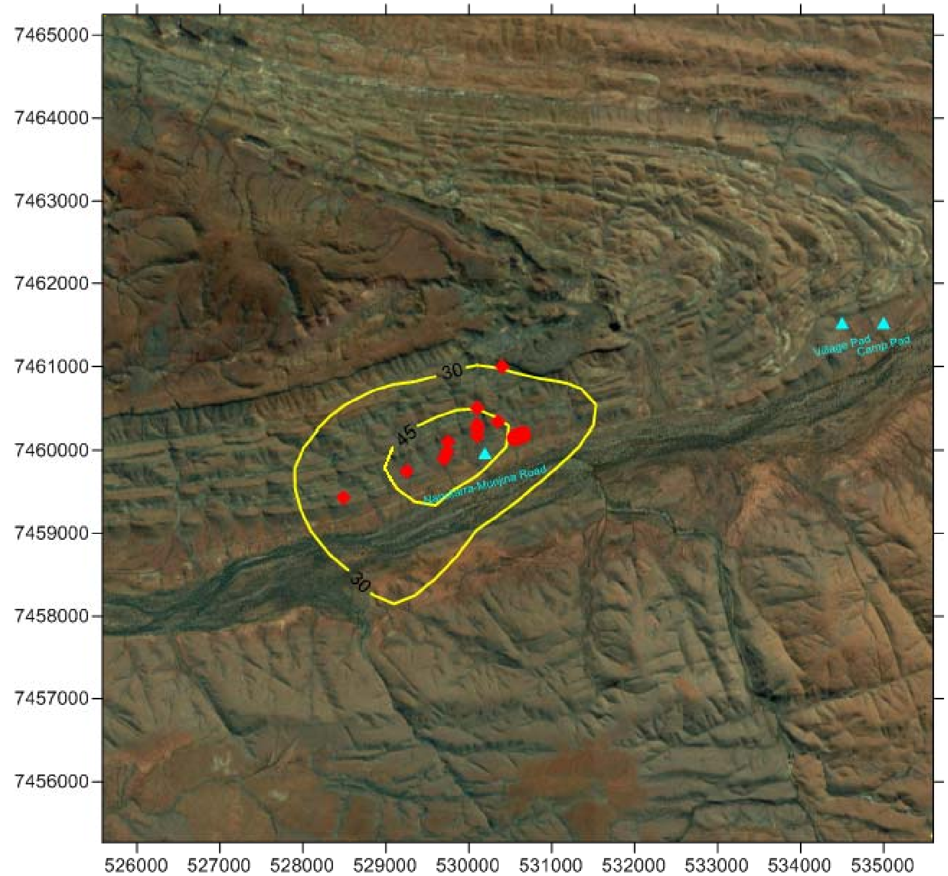


Figure 18: Predicted Ground Level Concentrations of PM_{10} + Background Concentration Annual Average (μg/m^3)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

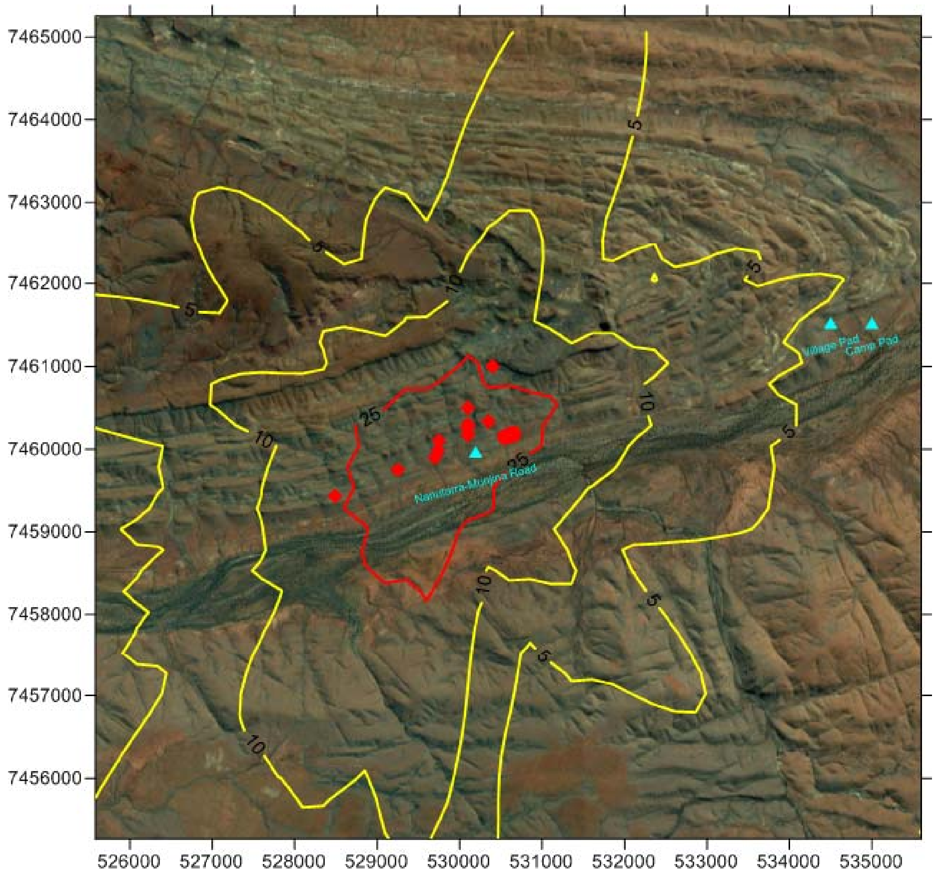


Figure 19: Predicted Ground Level Concentrations of $PM_{2.5}$ – 24 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

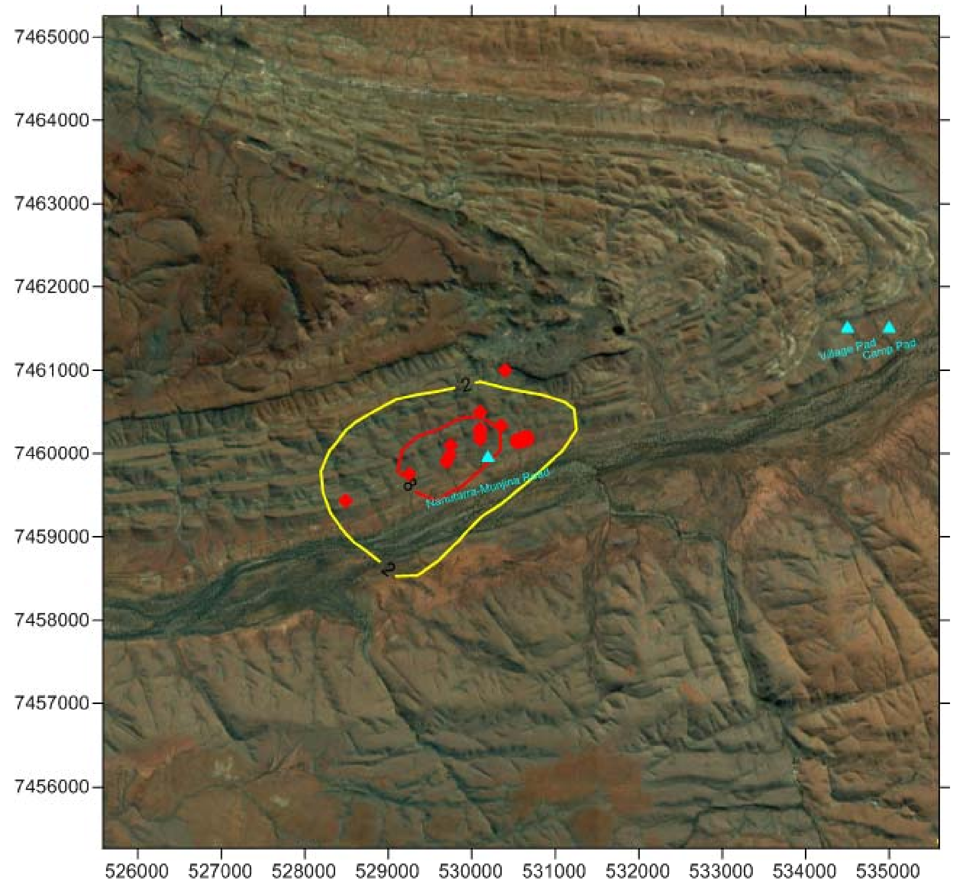


Figure 20: Predicted Ground Level Concentrations of $PM_{2.5}$ - Annual Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

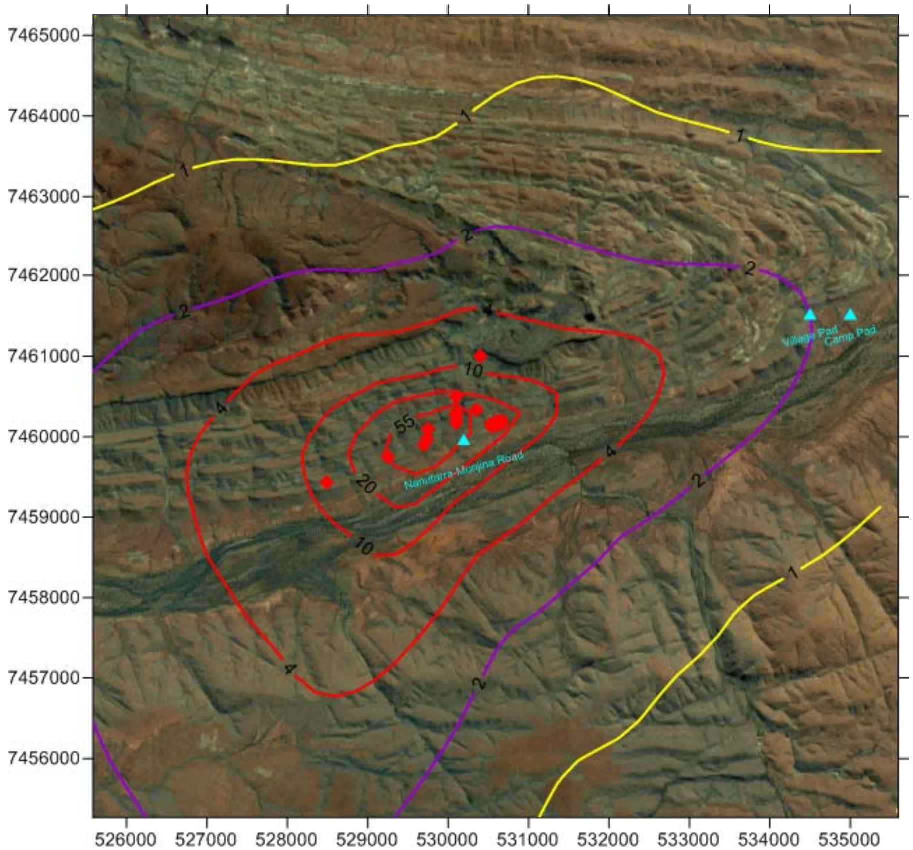


Figure 21: Predicted Ground Level Concentrations of Annual TSP Dust Deposition (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

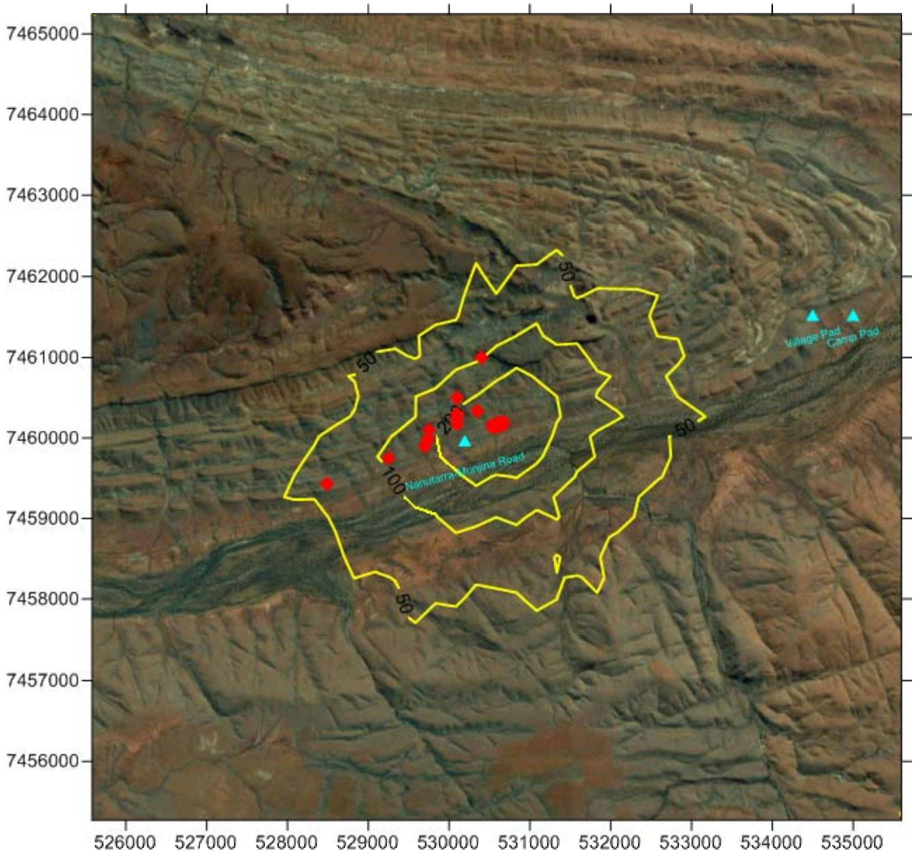


Figure 22: Predicted Ground Level Concentrations of CO - 8 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

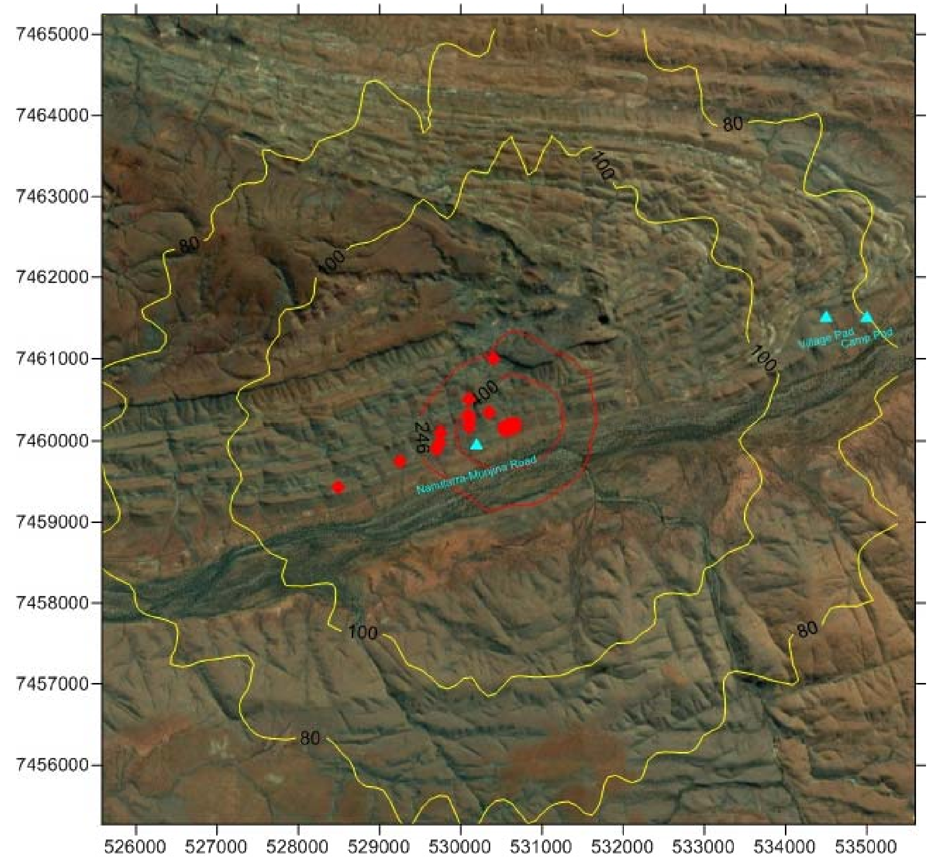


Figure 23: Predicted Ground Level Concentrations of NO_x - 1 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

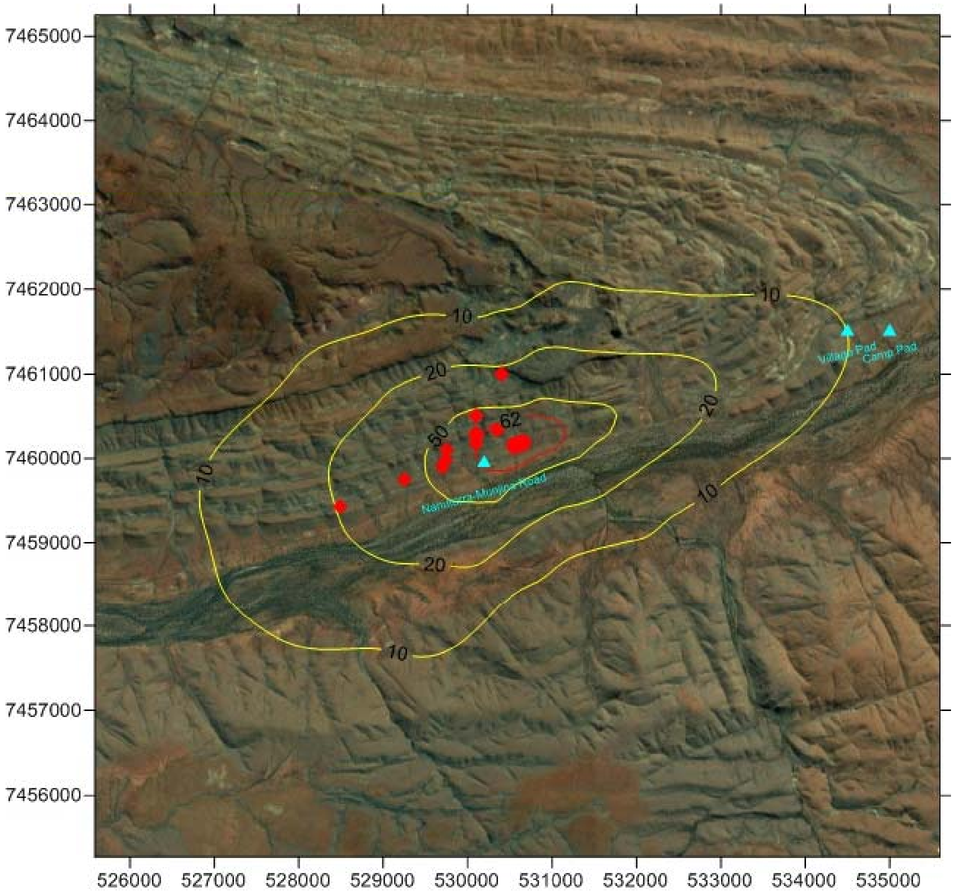


Figure 24: Predicted Ground Level Concentrations of NO_x Annual Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

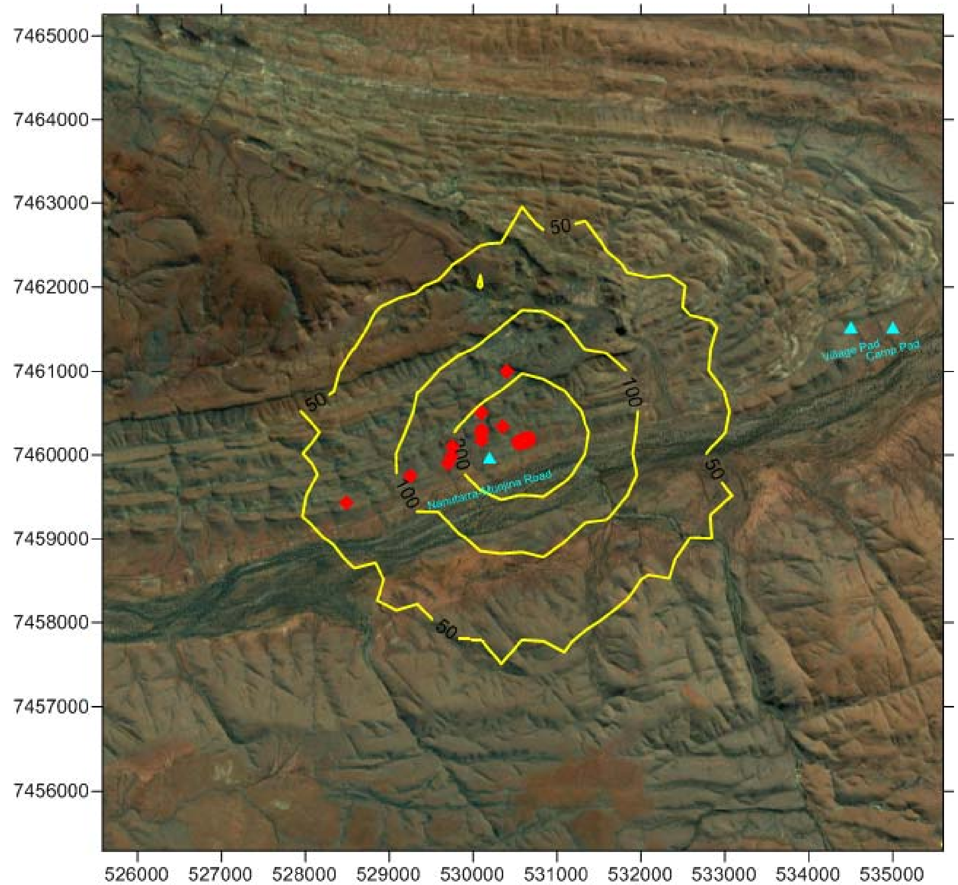


Figure 25: Predicted Ground Level Concentrations of SO_2 - 1 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

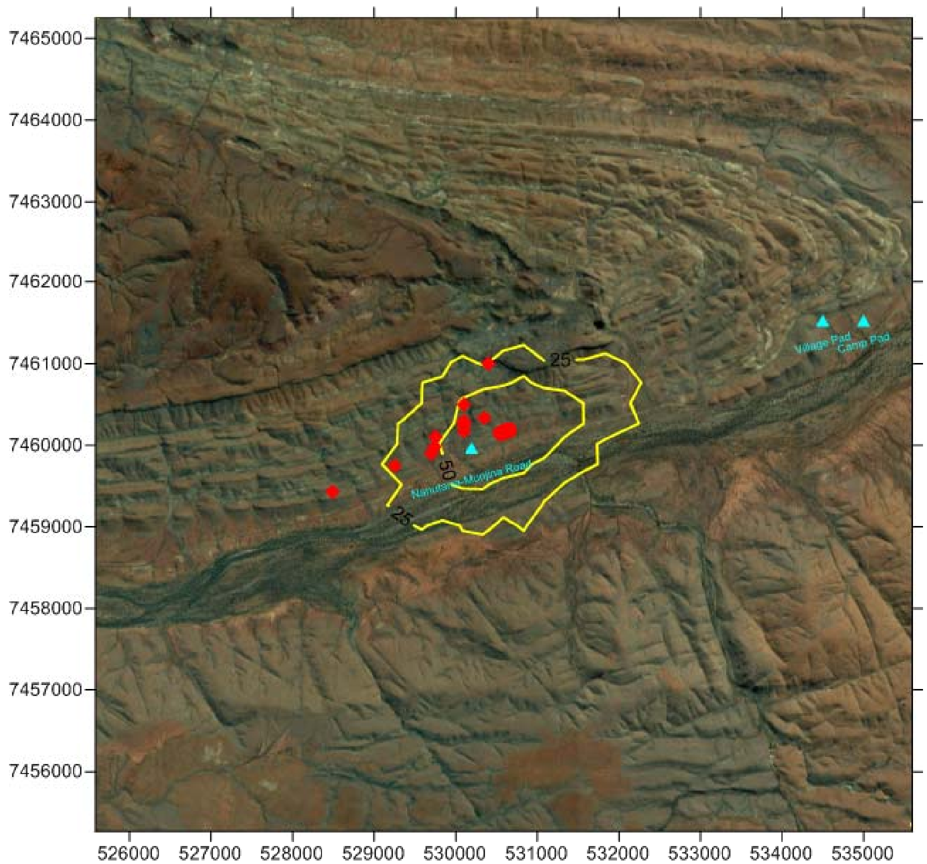


Figure 26: Predicted Ground Level Concentrations of SO_2 24 Hour Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

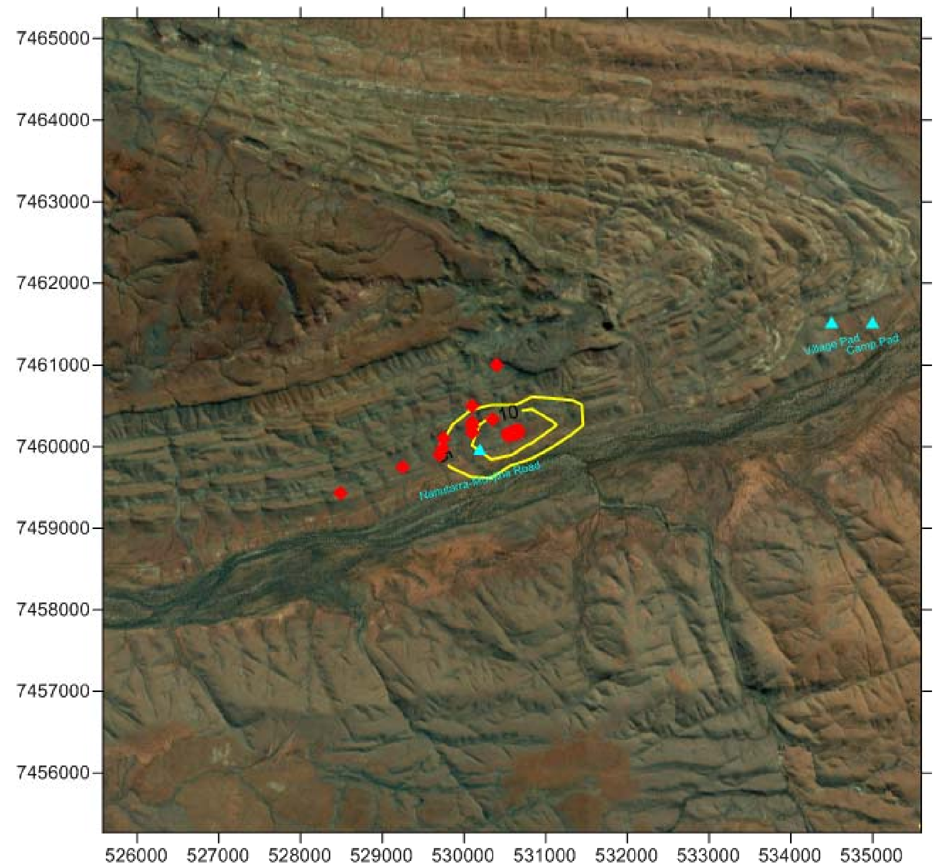


Figure 27: Predicted Ground Level Concentrations of SO_2 Annual Average (µg/m³)

Client: API Management Pty Ltd	ENVIRON	
Project: Hardey Processing Facility	Drawing Ref: AL	Date: 28/11/11

Appendix A
Sensitivity Analysis – TAPM Generated Ausplume Meteorological Data

Sensitivity Analysis – TAPM generated Ausplume Meteorological File

Ausplume was used to predict the ground level concentrations of particulate for two meteorological data sets:

1. using data generated solely by TAPM; and

2. using Paraburdoo Airport surface data and upper air data generated TAPM.

Paraburdoo Airport station is located approximately 52 km south-east of the mine site and is the closest meteorological monitoring station to the mine site that ENVIRON has been able to identify and obtain information for. Table A1 presents the Ausplume modelling results for the two meteorological data sets for the train loading dust source group.

Table A1: TSP results for Train Loading Source Group based on Observed & TAPM generated Ausplume Meteorological files.

Modelled Domain Maximum/Sensitive Receptor	Averaging Period	Paraburdoo Observed Ausplume File Predicted TSP Concentration (µg/m^3)	TAPM Generated Ausplume File Predicted TSP Concentration (µg/m^3)
Domain Maximum	Max 1-Hr	734	1056
	99.9th 1-Hour	540	743
	99.5th 1-Hour	291	566
	Max 24-Hour	67	143
	99.5th 24-Hour	54	116
	Annual	13	29
Permanent Village	Max 1-Hr	7	11
	99.9th 1-Hour	6	6
	99.5th 1-Hour	3	5
	Max 24-Hour	1	2
	99.5th 24-Hour	0.7	1.8
	Annual	0.07	0.19

The Ausplume outputs show that the maximum 1-hour, 99.9th percentile 1-hour, 24-hour and annual TSP dust concentrations predicted using the TAPM generated met file are higher than those predicted using the Paraburdoo wind speed and directions.

Table A2 shows the wind speed and wind direction distribution for the TAPM generated Ausplume meteorology in comparison to the Paraburdoo observed data. While TAPM under-predicted the frequency of calm wind conditions compared to the Paraburdoo data, it over-predicted the frequency of winds between 1 and 4 m/s. TAPM under-predicted the frequency of winds 5 to 10 m/s. The comparison of wind direction shows similar trends between the observed and predicted winds although TAPM predicts a higher frequency of westerly and a lower frequency of easterly winds when compared to the Paraburdoo data. These differences in the predicted wind directions are likely to be associated with the influence of the terrain on the meteorology of the Project Area.

Table A2: Wind Speed & Wind Direction Distribution

	Paraburdoo Observed Ausplume Meteorological File	TAPM Generated Ausplume Meteorological File
WD Distribution (deg)	**Percentage**	**Percentage**
>0 and <30	8.9%	7.9%
60	14.6%	11.6%
90	17.4%	14.3%
120	12.9%	11.7%
150	6.2%	7.2%
180	5.1%	4.5%
210	5.6%	6.1%
240	5.6%	7.8%
270	8.8%	13.6%
300	7.4%	6.9%
330	4.6%	4.6%
360	3.0%	3.8%
WS Distribution (m/s)	**Percentage**	**Percentage**
0	3.3%	0%
1	2.8%	4.1%
2	4.1%	16.9%
3	19.4%	34.5%
4	22.6%	25.1%
5	17.7%	12.9%
6	13.6%	4.9%
7	8.6%	1.2%

Table A2: Wind Speed & Wind Direction Distribution		
	Paraburdoo Observed Ausplume Meteorological File	**TAPM Generated Ausplume Meteorological File**
8	4.6%	0.3%
9	1.9%	0.1%
10	0.0%	0.8%

The sensitivity analysis includes a summary of the statistical measures used to evaluate the wind speeds as presented below.

1 **Index of Agreement (IOA):** IOA reflects how well the predicted data estimates the observed mean are represented. Hurley (2000) suggests that an IOA of 0.5 or greater represents a good correlation. An IOA of 1 means a perfect correlation between predicted and observed.

2 **Root mean square error (RMSE):** This is an acceptable average measure of the difference or error between predicted and observed values. Low RMSE values in a model indicate that the model is explaining most of the variation in the observations.

3 **Systematic (RMSE_S) and Unsystematic RMSE (RMSE_U):** If the model is unbiased rmse_s should approach 0 and rmse_u should be close to rmse.

In addition, model acceptability criteria summarized by Chang and Hanna (2004) based on extensive experience concluded that for comparison of predicted and observed values (unpaired in space) "acceptable" performing models have the following typical performance measures.

1 **Fractional Bias (FB):** The fraction of predictions within a factor of two of observations is about 50% or greater (i.e. FAC2>0.5).

2 **Geometric mean bias (GM):** The mean bias is within +30% of the mean (i.e. roughly│FB│<0.3 or 0.7<GM<1.3).

3 **Random Scatter as Normalized mean square error (NMSE) and Geometric Variance (VG):** The random scatter is about a factor of two to three of the mean (i.e., roughly NMSE <1.5 or VG<4).

4 **Standard Deviation (Predicted and Observed).** A model is predicting with skill if the standard deviations of the predictions and observations are approximately the same (Piekle 1984).

A summary of the statistical measures used to assess the performance of TAPM with respect to wind speed at the Paraburdoo Airport site is presented in Table A3.

Table A3: Performance Evaluation Summary – Wind Speed

Statistical Method	Performance Evaluation Criteria	Result
RMSE	<2	1.86
RMSE_S	n/a	2.21
RMSE_U	n/a	1.53
IOA	>60%	70%
Fractional Bias	>-0.3 and <0.3	0.16

Table A3: Performance Evaluation Summary – Wind Speed

Statistical Method	Performance Evaluation Criteria	Result
NMSE	<1.5	0.25
SD Observed	n/a	1.98
SD Predicted	n/a	1.42
Max Observed	n/a	13.9
Max Predicted	n/a	9.6
Avg Observed	n/a	4.0
Avg Predicted	n/a	3.4

The model evaluation results indicate that TAPM's skill level in predicting the wind speed is acceptable based on the comparison with the Paraburdoo monitoring data. The performance of TAPM is comparable to its performance observed at other sites in Australia based on ENVIRON's experience.

In summary, TAPM was chosen to generate the meteorological data for input into Ausplume for this study for a range of reasons including:

1. TAPM generated ground meteorological data presented acceptable correlations with observed wind speed and wind direction at Paraburdoo Airport. (See Figures 4-5)
2. The nearest upper-air monitoring data available is at Port Hedland Airport more than 300 km away from the study site.
3. The nearest ground meteorological data available is at Paraburdoo Airport – more than 52 km away from the study site.
4. Terrain is expected to influence the local meteorology in the Project Area.
5. The use of a TAPM generated meteorological data file in Ausplume was found to result in higher predicted concentrations than using the observed surface meteorological data from Paraburdoo Airport.

Appendix B
TAPM- Ausplume Meteorological Data File

Analysis of TAPM generated Ausplume Meteorological File

A1. Analysis of the TAPM generated Ausplume Meteorological Data

Table A1 presents a summary of the frequency occurrence of the atmospheric stability classes determined for the 12 month period.

Table A1: Frequency Occurrence of Atmospheric Stability Class

Hour	Frequency Occurrence of Stability Class					
	A	B	C	D	E	F
1				0.7%	1.4%	2.1%
2				0.7%	1.1%	2.3%
3				0.8%	1.0%	2.4%
4				0.8%	1.1%	2.3%
5				0.8%	1.2%	2.2%
6				2.5%	0.7%	1.0%
7				4.2%		
8			1.4%	2.8%		
9		1.3%	2.1%	0.8%		
10	0.5%	2.2%	1.4%	0.1%		
11	1.3%	2.0%	0.8%	0.1%		
12	1.7%	1.8%	0.7%	0.1%		
13	1.8%	1.8%	0.6%	0.1%		
14	1.6%	1.9%	0.6%	0.1%		
15	1.2%	2.2%	0.8%	0.1%		
16	0.2%	2.2%	1.6%	0.2%		
17		0.5%	1.9%	1.8%		
18			0.2%	4.0%		
19				2.2%	0.9%	1.1%
20				1.0%	1.5%	1.7%
21				0.9%	1.6%	1.7%
22				0.8%	1.6%	1.8%
23				0.7%	1.6%	1.8%
24				0.8%	1.5%	1.9%
All Data	8.1%	16%	12%	26%	15%	22%

A.8 Frequency Occurrence of Wind Speed and Wind Direction

The frequency occurrence of wind speed and wind direction based on the Ausplume meteorological data set derived from TAPM are summarised in Table A2.

Table A2: Wind Speed & Wind Direction Distribution

WD Distribution (deg)	Percentage
0	-
30	7.9%
60	11.6%
90	14.3%
120	11.7%
150	7.2%
180	4.5%
210	6.1%
240	7.8%
270	13.6%
300	6.9%
330	4.6%
360	3.8%
WS Distribution (m/s)	**Percentage**
0	0%
1	4.1%
2	16.9%
3	34.5%
4	25.1%
5	12.9%
6	4.9%
7	1.2%
8	0.3%
9	0.1%
10	0.0%

Appendix C
Sample Ausplume Input File

```
 6.0 version
**************************************************************
* WARNING - WARNING - WARNING - WARNING - WARNING - WARNING *
*                                                            *
* This is a generated file. Please do not edit it manually. *
* If  editing  is  required, under any circumstances do not *
* edit information enclosed in curly braces.  Corruption of *
* this information or changed order of data blocks enclosed *
* in curly braces may render the file unusable.             *
*                                                            *
**************************************************************

Simulation Title
{API Mining 15 Mtpa – PS3.8}
Concentration(1)/Deposition(0), Emission rate units, Concentration/Deposition units,Background Concentration, Variable Background flag,Variable Emission Flag
{True grams/second microgram/m3 0 False False }

Terrain influence tag, 0-ignore, 1 - include
{2}
Egan coefficients
{0.5 0.5 0.5 0.5 0.7 0.7 }
Number of source groups
{8}
Total number of sources (Stack + Area + Volume sources)
{8}
Source Group information
Total Number of Sources in Group 1
{1}
Sources in Source Group 1
{C1     }
Total Number of Sources in Group 2
{1}
Sources in Source Group 2
{C2     }
Total Number of Sources in Group 3
{1}
Sources in Source Group 3
{PS1    }
Total Number of Sources in Group 4
{1}
Sources in Source Group 4
{FT1    }
Total Number of Sources in Group 5
{1}
Sources in Source Group 5
{FP1    }
Total Number of Sources in Group 6
{1}
Sources in Source Group 6
{CO1    }
Total Number of Sources in Group 7
{1}
Sources in Source Group 7
{CO2    }
Total Number of Sources in Group 8
{1}
Sources in Source Group 8
{TR1    }
BPIP Run (1-True, 0-False)
{0 }
Total number of buildings
{3 }
Building name, Base elevation, Number of tiers
{PS     0 1 }
Height, Number of sides
{2 4 }
X coordinates
{530500 530550 530720 530700 }
Y coordinates
{7460250 7460130 7460160 7460300 }
```

Building name, Base elevation, Number of tiers
{CRUSH 0 1 }
Height, Number of sides
{15 4 }
X coordinates
{530100 530100 530050 530050 }
Y coordinates
{7460250 7460150 7460150 7460250 }
Building name, Base elevation, Number of tiers
{SCREEN 0 1 }
Height, Number of sides
{15 4 }
X coordinates
{529739 529707 529844 529861 }
Y coordinates
{7459983 7460055 7460220 7460157 }

Source Information

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{TR1 3 530100 7460500 380 }
Source height
{3 0 }
Side length, Effective Radius
{3 2.5 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{C1 3 530050 7460250 380 }
Source height
{6.5 0 }
Side length, Effective Radius
{6.5 5.1 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{C2 3 530000 7460200 380 }
Source height
{13 0 }
Side length, Effective Radius
{13 5.1 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions

{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{PS1 3 529800 7460050 380 }
Source height
{4.5 0 }
Side length, Effective Radius
{8 4 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{FT1 3 529700 7459900 370 }
Source height
{2.5 0 }
Side length, Effective Radius
{8 4 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{FP1 3 529250 7459750 400 }
Source height
{50 0 }
Side length, Effective Radius
{50 15 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }

Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{CO1 3 530100 7460174 380 }
Source height
{2.5 0 }
Side length, Effective Radius
{5 4 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{CO2 3 529750 7460100 380 }
Source height
{2.5 0 }
Side length, Effective Radius
{5 4 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-temperarture), Position in Array, Number of particle fractions
{1 1 }
Constant emission rate
{1}
Deposition fraction proportions
{1 }
Particle sizes
{3.8 }
Particle densities
{1 }
Water scavenging
{0 }
Ice scavenging
{0 }

Receptor information

Discrete receptors
Receptor coordinates type (1-Cartesian,0-Polar),Number of Receptors
{1 3 }
X, Y coordinates and Elevation
{534500 7461500 0 }
X, Y coordinates and Elevation
{535000 7461500 0 }
X, Y coordinates and Elevation
{530193 7459944 0 }

Gridded receptors
Receptor coordinates type (1-Cartesian, 0-Polar), Number of X and Y coordinates, Receptor height
{1 40 40 0 }

X grid coordinates

{525583 525833 526083 526333 526583 526833 527083 527333 527583 527833 528083 528333 528583 528833 529083 529333 529583 529833 530083 530333 530583 530833 531083 531333 531583 531833 532083 532333 532583 532833 533083 533333 533583 533833 534083 534333 534583 534833 535083 535333 }

Y grid coordinates
{7455266.68 7455516.68 7455766.68 7456016.68 7456266.68 7456516.68 7456766.68 7457016.68 7457266.68 7457516.68 7457766.68 7458016.68 7458266.68 7458516.68 7458766.68 7459016.68 7459266.68 7459516.68 7459766.68 7460016.68 7460266.68 7460516.68 7460766.68 7461016.68 7461266.68 7461516.68 7461766.68 7462016.68 7462266.68 7462516.68 7462766.68 7463016.68 7463266.68 7463516.68 7463766.68 7464016.68 7464266.68 7464516.68 7464766.68 7465016.68 }
Model settings and parameters
Emission conversion factor, Averaging Time
{1000000 0 }

Land use (surface roughness)
{0.4}
Averaging time flags (1,2,3,4,6,8,12,24 hrs, 7, 90 days, 3 month, All hrs
{1 0 0 0 0 0 0 0 0 0 0 0 }
Statistical output options
{0 0 }
Output options (All meteodata, Every concentration/deposition, Highest/2nd highest, 100 worst case table, Save all calculations
{0 1 0 0 0 0 }
Write concentration (1-yes, 0-no), Concentration rank, Write frequency, Frequency Level
{0 1 0 -1 }

Disregard exponents (1-yes, 0-no), Exponent Scheme (1-Irvin urban, 2-Irvin rural, 3-ISCST, 4-User Defined
{0 2 }
Dispersion exponents
{0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.2 0.2 0.2 0.2 0.2 0.2 0.25 0.25 0.25 0.25 0.25 0.25 0.4 0.4 0.4 0.4 0.4 0.4 0.6 0.6 0.6 0.6 0.6 0.6 }

Building wake effects (1-include,0-not) , Default decay coefficient, Anemometr height, Sigma-theta averaging period, Roughness at vane site, Smooth stability changes, ConvectivePDF)
{1 0 10 60 0.3 0 0 }

Deposition options, Depletion options
{False False False False True False }

Stability class adjustments (0-None, 1-Urban1, 2-Urban2)
{0}
Building wake algorithms (1-Huber-Sneider, 2-Hybrid, 3-Schulman-Scire)
{4}

Gradual plume rise (1-yes,0-no), Stack tip downwash (1-yes,0-no), Disregard Temperature Gradient (1-yes,0-no), Partial Penetration, Temp Gradient, Adiabatic Entrainment, Stable Entrainment
{1 1 0 0 0.004 0.6 0.6 }
Temperature Gradients for Wind and Stability categories
{0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.02 0.02 0.02 0.02 0.02 0.02 0.035 0.035 0.035 0.035 0.035 0.035 }

Dispersion curves (1-Pasquill Gifford, 2- Briggs rural, 3-Sigma theta) horizontal < 100 m, ditto vertical < 100 m, ditto horizontal > 100 m, ditto vertical > 100 m
{1 1 2 2 }
Adjust PG curves for roughness - Horizontal, Vertical (1-yes,0-no)
{1 1 }
Enhance plume for buyoancy - Horizontal, Vertical (1-yes,0-no)
{1 1 }
Adjust for wind direction shear
{0}
Shear rates
{0.005 0.01 0.015 0.02 0.025 0.035 }
Wind Speed categories
{1.54 3.09 5.14 8.23 10.8 }
Output file
{'C:\API\PS3.8.TXT'}
Meteorological file
{'C:\API\APIMet2010.met'}
Receptor file
{'C:\API\ausplume.ter'}