AIR QUALITY IMPACT ASSESSMENT

KENDALL BAY
REMEDIATION PROJECT

Jemena

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Prepared by

Todoroski Air Sciences Pty Ltd

Suite 2B, 14 Glen Street

Eastwood, NSW 2122

Phone: (02) 9874 2123

Fax: (02) 9874 2125

Email: info@airsciences.com.au

Air Quality Impact Assessment
Kendall Bay Remediation Project

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Jemena (hereafter referred to as the Proponent). It presents an assessment of the potential air quality impacts associated with the proposed sediment remediation works in Kendall Bay, New South Wales (NSW) (hereafter referred to as the Project).

The Project essentially seeks to remediate the contaminated sediment in two areas of Kendall Bay. Former activities associated with the Mortlake Gasworks including the loading and unloading of coal and other materials and other activity is the likely cause of the contamination.

To assess the potential air quality impacts associated with the Project, this report incorporates the following aspects:

- A background and description of the Project;
- A summary of air emission sampling of contaminated material at the Project;
- A review of the existing meteorological and air quality environment surrounding the Project;
- A description of the dispersion modelling approach used to assess potential air quality impacts;
- Presentation of the predicted results and discussion of the potential air quality impacts; and,
- Discussion on potential mitigation and management measures as required.

2 LOCAL SETTING

The Project is located approximately 10 kilometres (km) west of Sydney Central Business District (CBD) and approximately 11km east-southeast of Parramatta CBD. The proposed remediation areas are situated on the south side of the Parramatta River and located directly to the east of the Breakfast Point residential development and northwest of Cabarita.

The land use in the surrounding area is characterised by predominantly dense residential areas with some light industrial and commercial operations at Mortlake. Public access parklands are located to the south and the east of the remediation areas with a pedestrian pathway leading along the perimeter of Kendall Bay.

Figure 2-1 presents the location of the Project and selected sensitive receptor locations considered in this study. **Appendix A** provides a detailed list of the receptors assessed.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project area. The area near the Project site can be characterised as relatively flat with the surrounding terrain generally sloping towards the Parramatta River within the numerous bays along the water's edge. The areas to the north of the Parramatta River are typically more elevated than the areas to the south. The local terrain and other features in this area would have an effect on wind patterns and also the dispersion of air emissions.

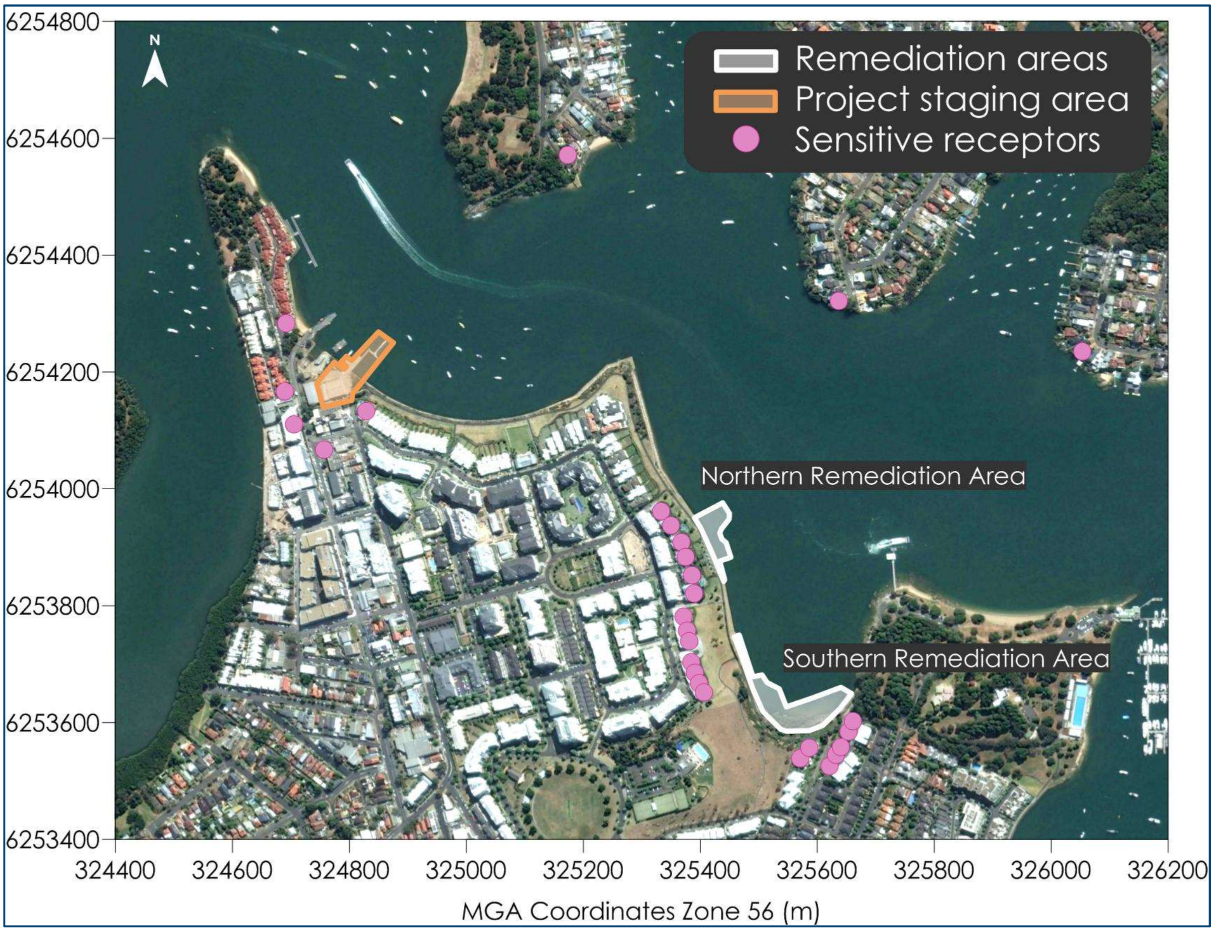

Figure 2-1: Project location

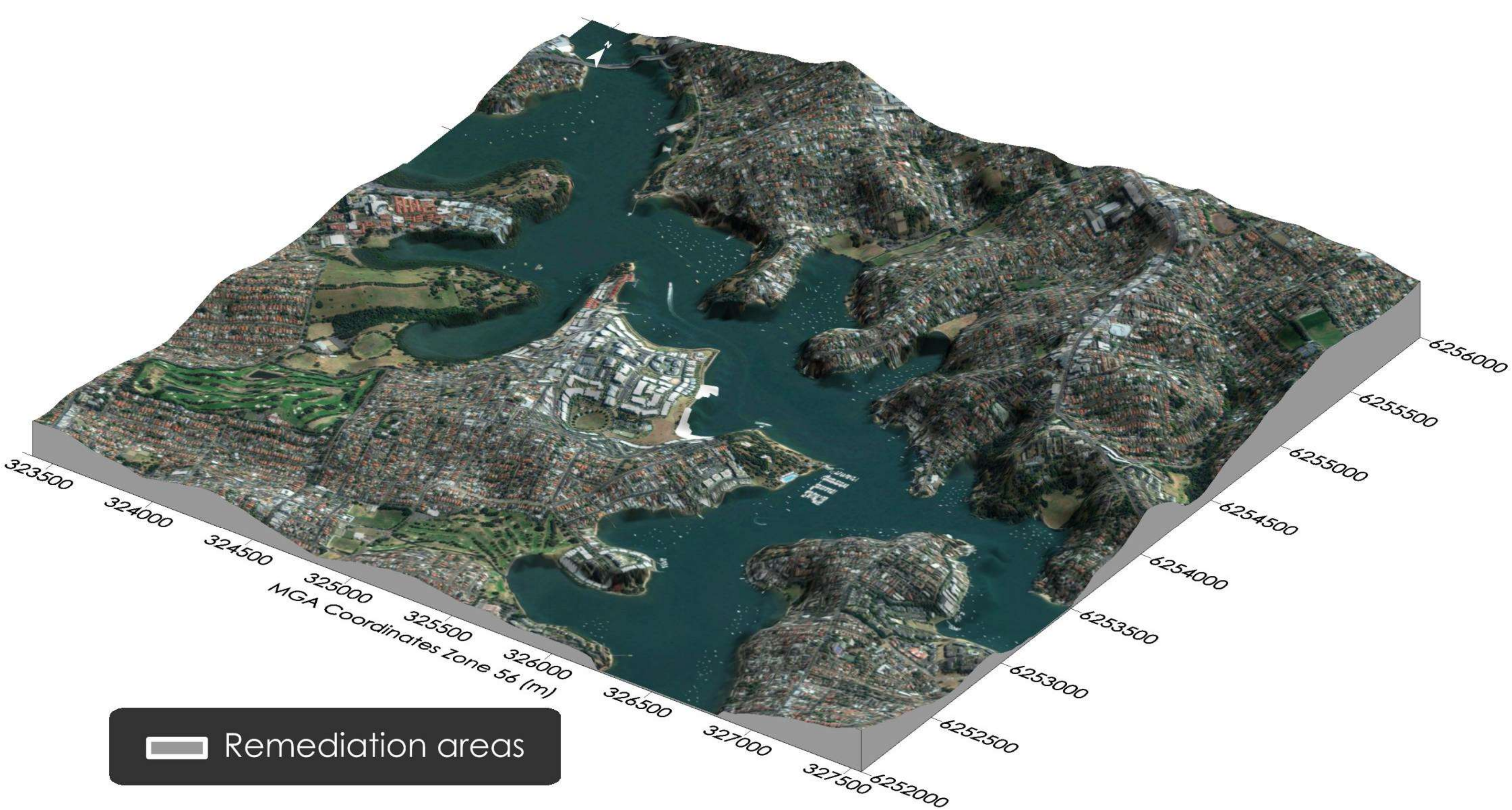

Figure 2-2: Representative view of the topography surrounding the Project location

3 PROJECT DESCRIPTION

3.1 Project area

The proposed remediation works will occur in two separate areas, the Southern Remediation Area (formerly Area A) and the Northern Remediation Area (formerly Area B) (see **Figure 2-1**).

The Southern Remediation Area occupies an area of approximately 8,500m^2 and is situated within the southern portion of Kendall Bay, extending into the southern and western shoreline areas. The Northern Remediation, located adjacent to the western shoreline of Kendall Bay, occupies an area of approximately 4,000m^2.

The staging area at Tennyson Road provides direct access to Parramatta River to enable ready barge access to Kendall Bay allowing for the contaminated materials to be transported off-site.

3.2 Remediation methodology

The key activities to remediate the site include:

- The excavation of contaminated sediment materials using an excavator on a floating barge.
- Excavated material will be placed by the excavator directly into bins positioned on a separate floating barge. Small bins would be used to minimise the potentially exposed surface area at any one time (approx. 2.5m^2). Care will be taken to place material carefully in bins and avoid spillage.
- Bins will have close fitting, essentially airtight lids. The contaminated material would be thus sealed in the bins.
- The barge holding the bins will be transported over water to the staging area where the sealed bins are transferred to land.
- Exterior of the bins will be washed down on the barge and any wash water collected within the bunds of the barge. This water is periodically sucked out by vacuum tanker and disposed off-site to a licenced water treatment plant.
- Sealed bins will be transferred to trucks for transport off-site to a licenced facility for further treatment (if required) and disposed at licenced landfill facility.

Excavation activity is proposed to occur from 7:00am to 5:00pm Monday to Friday and 8:00am to 1:00pm on Saturday.

4 POLLUTANT SAMPLING

The activities associated with the proposed remediation works have the potential to emit a range of odorous and volatile substances due to the nature of the contaminated materials.

Site specific sampling of the contaminated silt material was conducted in order to characterise the potential air emissions that may arise during the proposed remediation works.

This section outlines the results of the site specific sampling undertaken and characterises the likely air pollutants that may arise from the proposed remediation activity at the Project.

4.1 Odour sampling

Site specific odour sampling was conducted using isolation flux hoods on 15 February, 16 February, 9 March and 10 March, 2016.

Odour measurements were performed at various locations across the Project site (see **Figure 4-1**). The odour sampling included sampling of the water surface, the exposed shoreline before and after disturbance and of core samples extracted from the contaminated areas.

Figure 4-1: Sampling locations

The measured odour sampling data are presented in **Table 4-1**. Significant variation in the measured odour emissions can be observed, dependent on the sampling location. This is likely to be due to two key factors, variable levels of contamination in the remediation areas associated with different activity occurring in the past and water and soil movements, but also difficulties encountered in collecting the material due to very soft sediment.

Table 4-1: Odour sampling data for the remediation areas

Sample ID	Sample location	Type	SOER ($OU.m^3/m^2/s$)
15201A	Southern	Water surface	0.099
16206A	Southern	Shoreline – undisturbed	0.1
16207A	Southern	Shoreline – disturbed	0.46
09303A	Southern	Sediment	1.3
09304A	Southern	Sediment	0.59
09305A	Southern	Sediment	0.3
09306A	Southern	Sediment	3.4
09307A	Southern	Sediment	0.25
15203B	Northern	Sediment	3.1
15202Bw	Northern	Water surface	0.17
15204Bw	Northern	Water surface	0.26
15205B	Northern	Sediment	0.43
9301B	Northern	Sediment	0.93
9302B	Northern	Sediment	2.0
09308B	Northern	Sediment	0.16
10309B	Northern	Sediment	8.9
10310B	Northern	Sediment	8.1

SOER = specific odour emission rate

Observations during the site sampling confirm that the most contaminated material has a mothball-like odour which is typical of gas works remediation sites. This odour is recognisable as a chemical odour, and could at times be detected near the shore at low tide (without any activity occurring).

Figure 4-2 shows the variation in the measured odour concentrations in the sampled sediment material (baseline water surface and shoreline samples excluded). The data show a large spatial variability, and it needs to be noted that it was not possible to obtain samples in deeper water away from the shoreline, nor at every point where it was attempted to collect a sample.

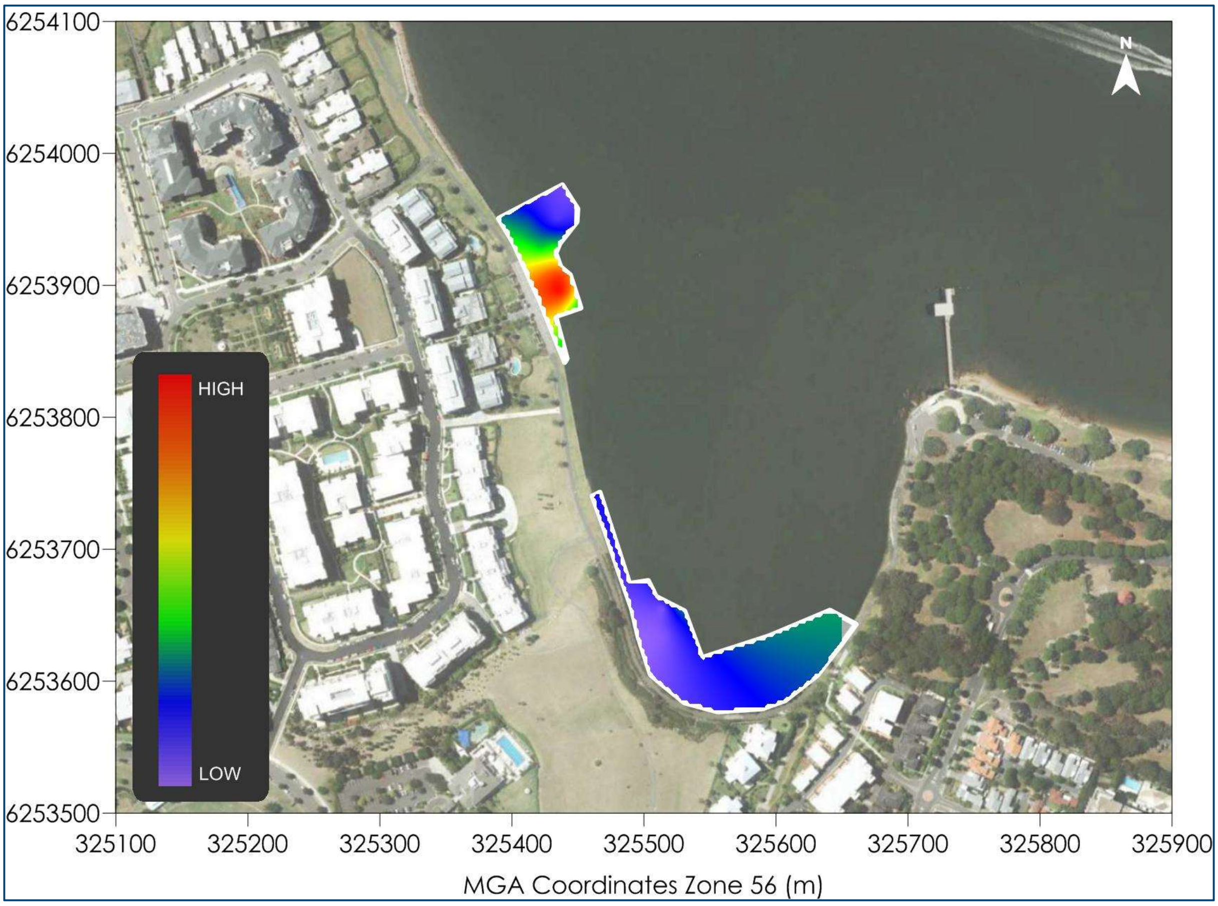

Figure 4-2: Estimated spatial variation in the measured odour concentrations (sediment only).

4.2 Other pollutant sampling

Core sampling of the sediment material was conducted between April 2015 and April 2016.

A total of 594 samples were collected and analysed at various core depths over the Project area.

Table 4-2 presents the mean value for the measured concentration in the sediment of the key volatile pollutants relevant to this study. These pollutants are relevant as they have a sufficiently high vapour pressure to be potentially released into the air form the water saturated sediment during handling. Other pollutants, such as metals and PAH's with low and very low inherent vapour pressure would not be released in any tangible quantity, as confirmed by screening the measured data per a soil vapour pressure model (and conservatively assuming the sediment material is not water saturated).

Table 4-2: Summary of other pollutant sampling (mg/kg of sediment)

Pollutant	Average
Benzene	0.8
Toluene	1.5
Ethyl Benzene	1.4
m, p - Xylene	2.7
o - Xylene	1.6

5 AIR QUALITY ASSESSMENT CRITERIA

5.1 Preamble

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the Project and the applicable air quality criteria.

5.2 Odour

5.2.1 Introduction

Odour in a regulatory context needs to be considered in two similar, but different ways depending on the situation.

NSW legislation (*Protection of the Environment Operations Act, 1997)* prohibits emissions that cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character and so on and to determine whether the odour would interfere with the comfort and repose of the normal person unreasonably. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

The range of an individual's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. The wide ranging response in how any particular odour is perceived by any individual poses specific challenges in the assessment of odour impacts and the application of specific air quality goals related to odour. The NSW Odour Policy (**NSW DEC, 2006**) sets out a framework specifically to deal with such issues.

It needs to be noted that the term odour refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical very rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odour, or more simply odour.

For activities with potential to release significant odour it may be necessary to predict the likely odour impact which may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that such odour reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

The NSW criteria for acceptable levels of odour range from 2 to 7 OU, with the more stringent 2 OU criteria applicable to densely populated urban areas and the 7 OU criteria applicable to sparsely populated rural areas, as outlined below.

5.2.2 Complex Mixtures of Odorous Air Pollutants

Table 5-1 presents the assessment criteria as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**). This criterion has been refined to take into account the population densities of specific areas and is based on a 99th percentile of dispersion model predictions calculated as 1-second averages (nose-response time).

Table 5-1: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Source: NSW DEC, 2005

The NSW odour goals are based on the risk of odour impact within the general population of a given area. In sparsely populated areas the criteria assume there is a lower risk that some individuals within the community would find the odour unacceptable, hence higher criteria apply.

However, the NSW EPA has recently been requesting that the odour criteria be determined on the basis of the number of receptors within the modelled 2 OU contour line. Hence it is not possible to establish criteria before conducting the modelling assessment. The applicable criteria in this case are thus outlined as part of the modelling results.

5.2.3 Peak to mean factors

Peak-to-mean factors are applied to account for any odour fluctuation above and below the mean odour level of the 1-hour averaging time. The criteria in **Table 5-1** are compared with modelled results that include peaking factors to account for the time-averaging limitations of air dispersion models. The peak-to-mean factors developed by **Katestone Scientific Pty Ltd (1995, 1998)** for NSW EPA are applied to convert the modelled (1-hour) averaging time to 1-second peak concentrations which are appropriate.

A summary of the peak-to-mean values is provided in **Table 5-2**.

Table 5-2: Peak-to-mean ratios

Source Type	Pasquill-Gifford stability class	Near field P/M 60*	Far field P/M 60*
Area	A, B, C, D	2.5	2.5
	E, F	2.3	1.9
Line	A-F	6	6
Surface point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

*Ratio of peak 1-second average concentrations

5.3 Other pollutants

The other pollutants identified in the contaminated material which have potential to be released have impact assessment criteria set out in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**), as outlined in **Table 5-3**.

Table 5-3: Impact assessment criteria for other pollutants

Substance	Averaging period	Impact assessment criteria (µg/m³)
Benzene	1 hour	29
Ethylbenzene	1 hour	8000
Toluene	1 hour	360
Xylenes	1 hour	190

Source: NSW EPA, 2017

6 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

6.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Sydney Olympic Park (Site No. 066195) were used to characterise the local climate in the proximity of the Project. The Sydney Olympic Park station is located approximately 4km west-southwest of the Project.

Table 6-1 and **Figure 6-1** present a summary of data from the Sydney Olympic Park weather station collected over a 14 to 16-year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 28.4 degrees Celsius (°C) and July as the coldest month with a mean minimum temperature of 7.8°C.

Rainfall peaks during the months of summer and autumn and declines during late winter and early spring. The data indicate that February is the wettest month with an average rainfall of 109.8millimetres (mm) over 7.7 days and September is the driest month with an average rainfall of 52.7mm over 5.5 days. Average annual rainfall for the station is 911.8 mm occurring over an average of 82.3 days.

Humidity levels exhibit little variability and seasonal flux across the year. Mean 9am humidity levels range from 56 per cent (%) in October to 72% in February and March. Mean 3pm humidity levels range from 41% in August to 55% in February.

Wind speeds during the warmer months tend to have a greater spread between the 9am and 3pm conditions compared to the colder months. Mean 9am wind speeds range from 8.4 kilometres per hour (km/h) in March to 11.9km/h in September. Mean 3pm wind speeds range from 12.5km/h in June to 19.4km/h in December.

Table 6-1: Monthly climate statistics summary – Sydney Olympic Park weather station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	28.4	28.1	26.6	23.9	20.8	18.3	17.6	19.5	22.5	24.3	25.3	27.4	23.6
Mean min. temp. (°C)	19.3	19.4	17.8	14.3	11.2	8.9	7.8	8.7	11.6	13.7	15.8	17.9	13.9
Rainfall													
Rainfall (mm)	84.4	109.8	66.0	89.2	88.2	75.8	63.5	56.7	52.7	64.9	76.2	58.0	911.8
No. of rain days (≥1mm)	7.6	7.7	7.6	6.9	7.7	6.9	6.3	4.4	5.5	7.1	7.8	6.8	82.3
9am conditions													
Mean temp. (°C)	22.3	21.9	20.3	18.0	14.6	12.0	11.2	12.9	16.4	18.7	19.6	21.5	17.4
Mean R.H. (%)	67	72	72	68	70	71	68	61	57	56	64	64	66
Mean W.S. (km/h)	9.6	9.3	8.4	9.5	10.5	10.9	11.0	11.6	11.9	11.1	11.4	10.0	10.4
3pm conditions													
Mean temp. (°C)	26.3	26.1	24.9	22.4	19.5	17.3	16.6	18.1	20.6	22.1	23.2	25.3	21.9
Mean R.H. (%)	53	55	53	51	51	52	48	41	43	45	51	50	49
Mean W.S. (km/h)	19.0	17.3	16.0	14.2	12.6	12.5	13.5	15.8	17.6	18.6	19.3	19.4	16.3

Source: **Bureau of Meteorology, 2018 (accessed June 2018)**

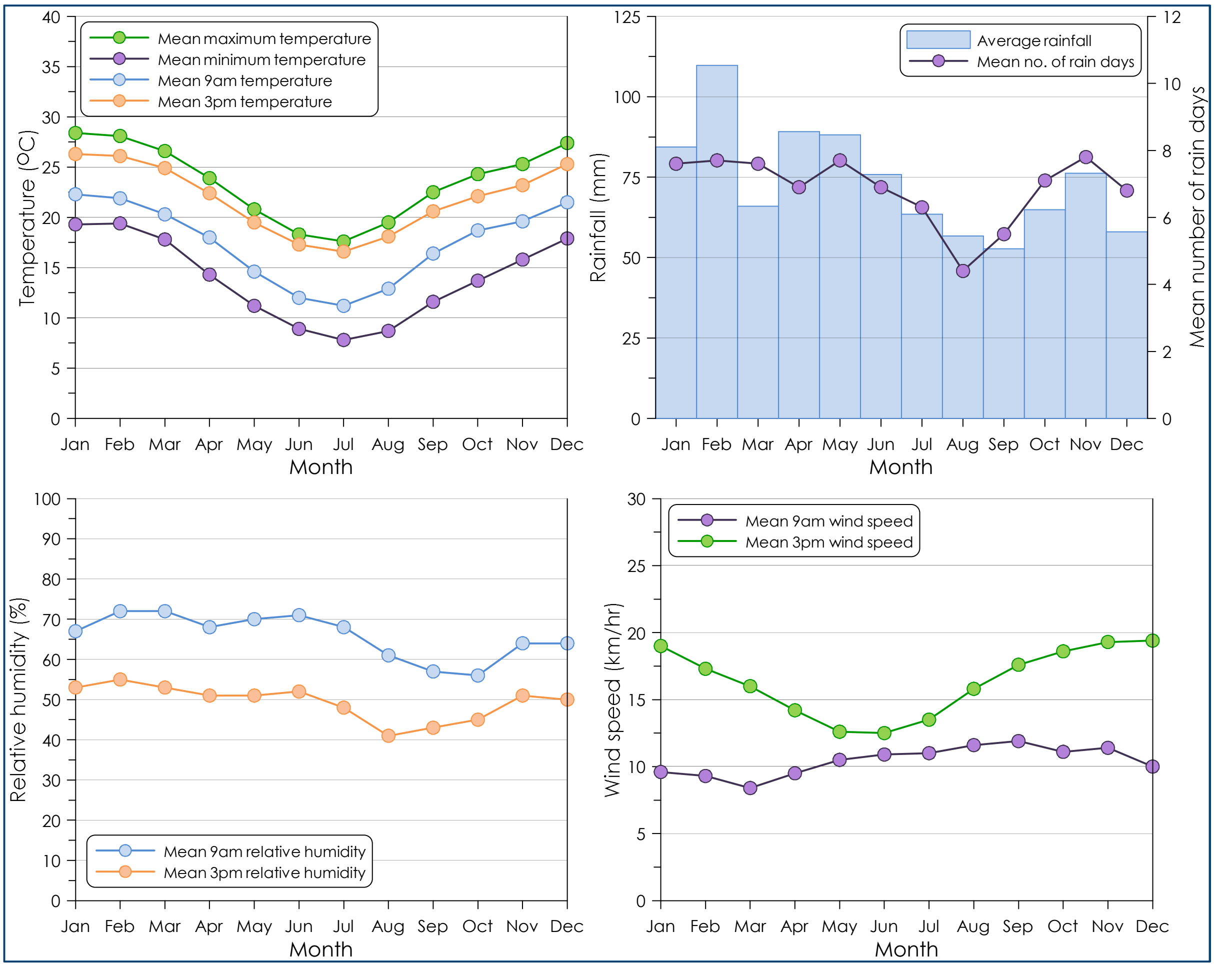

Figure 6-1: Monthly climate statistics summary – Sydney Olympic Park weather station

6.2 Local meteorological conditions

The Sydney Olympic Park AWS has been used to represent local meteorological conditions that would be experienced at the Project site. Annual and seasonal windroses prepared from data collected from the 2012 calendar year are presented in **Figure 6-2**. The 2012 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area as outlined in **Appendix A**.

On an annual basis, the highest portion of winds originate from the west-northwest and northwest, followed by winds from the east. In summer, winds are typically from the east and southeast quadrant. The autumn and winter distributions are similar to the annual distribution with predominate winds from west-northwest and northwest. During spring, winds occur from the west-northwest and east, with fewer winds from the southeast.

Figure 6-2: Annual and seasonal windroses for Sydney Olympic Park AWS (2012)

7 DISPERSION MODELLING APPROACH

7.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment. CALPUFF is an advanced air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the modelling domain in a three-dimensional, hourly varying time step.

The model was setup in general accord with the methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC**, **2011**).

7.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System and The Air Pollution Model (TAPM). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets.

TAPM is a prognostic air model used to simulate the upper air data for CALMET input. The meteorological component of TAPM is an incompressible, non-hydrostatic, primitive equation model with a terrain-following vertical coordinate for three-dimensional simulations. The model predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analysis.

The CALMET meteorological model uses the geophysical information and observed/simulated surface and upper air data as inputs to develop wind and temperature fields on a three-dimensional gridded modelling domain. CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion processes along the way. It uses the three dimensional meteorological field generated by CALMET. CALPOST is at tool used to process the output of the model and produce tabulations that summarise the results of the simulation.

7.2.1 Meteorological modelling

The TAPM model was applied to generate a meteorological data for use in CALMET. The centre of analysis for the TAPM modelling used is 33deg 50.5min south and 151deg 6.5min east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 35 vertical grid levels.

The CALMET domain was run initially on a 50 x 50km grid with a 1km grid resolution with input meteorological data from TAPM and refined for a 10 x 10km grid with a 0.1km grid resolution. The 2012 calendar year is selected as the period for modelling based on an analysis of long-term data trends in the available recorded meteorological data in **Appendix B**.

Local land use and detailed topographical information was included to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 7-1**.

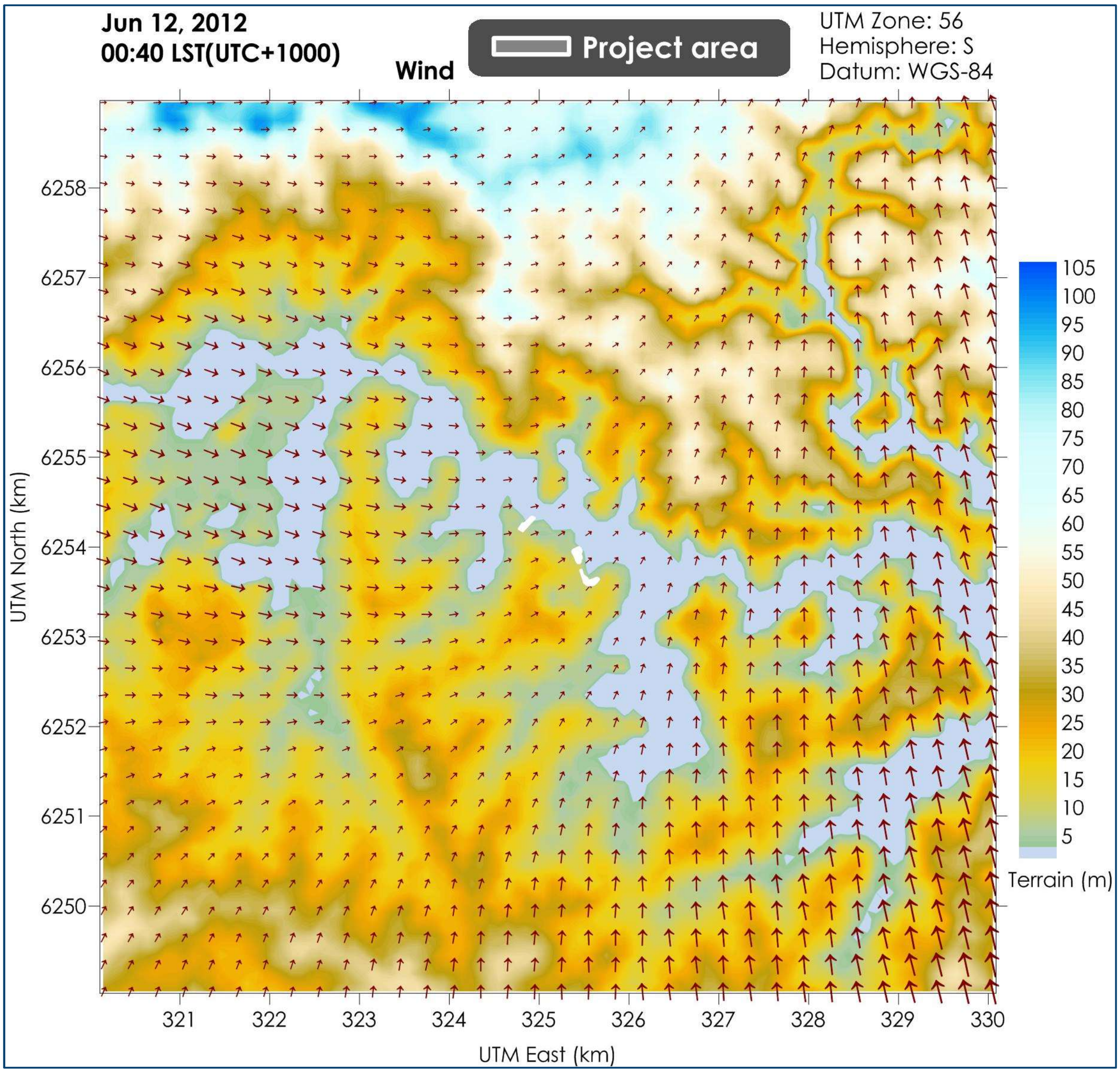

Figure 7-1: Representative 1-hour average snapshot of wind field for the Project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 7-2** and **Figure 7-3**.

Figure 7-2 presents annual and seasonal windroses extracted from one point in the CALMET domain. On an annual basis, winds from the west-northwest most frequent. During summer, winds from the northeast and southeast quadrants are most dominant. In autumn winds tend to occur from the west-northwest. The winter wind distribution has a high proportion of winds from west-northwest. The spring distribution is varied, typically dominated by winds from the west-northwest.

Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected effects of the terrain and local features influencing the prevailing wind flows.

Figure 7-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and shows sensible trends considered to be representative of the area.

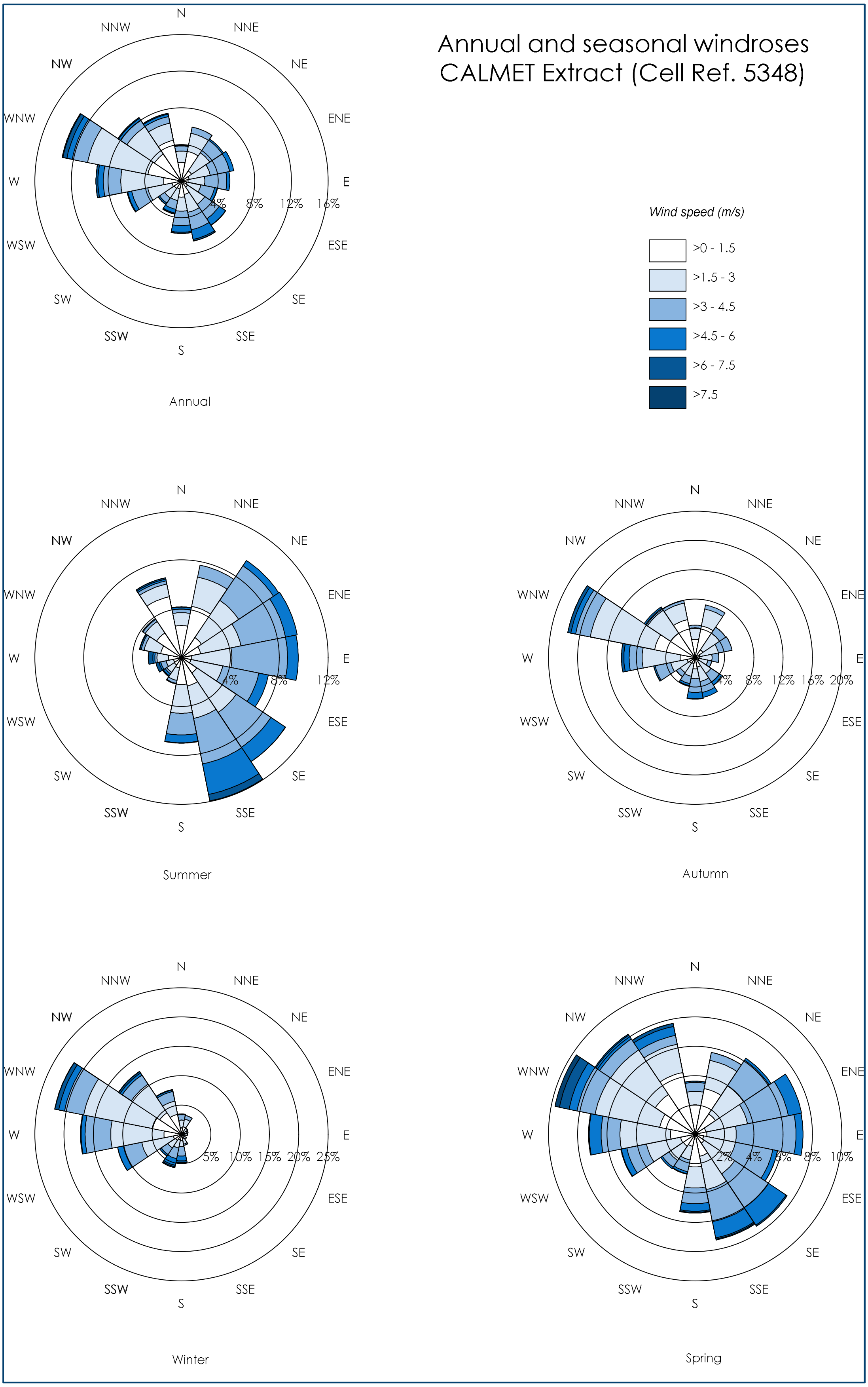

Figure 7-2: Annual and seasonal windroses from CALMET (Cell ref 5348)

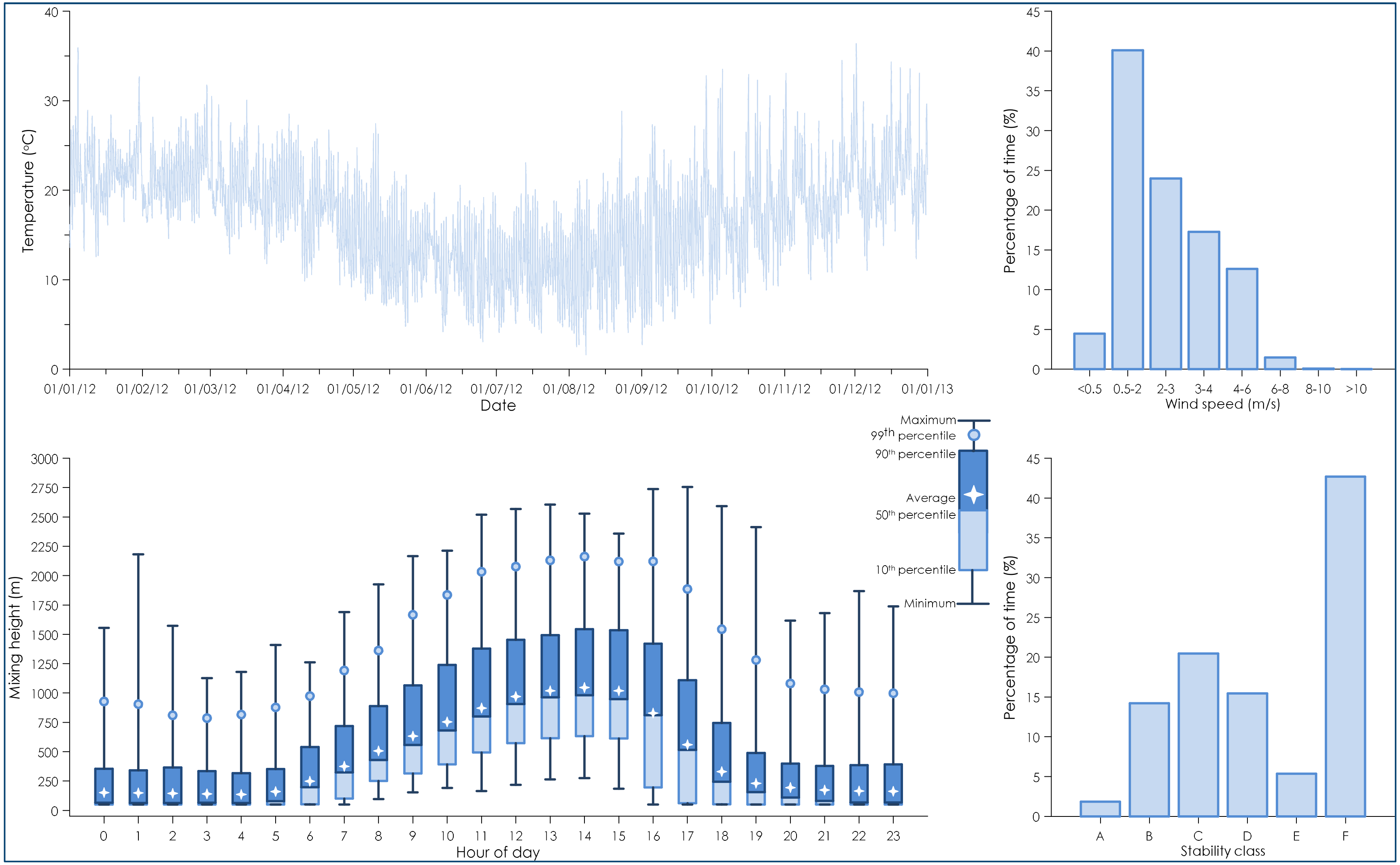

Figure 7-3: Meteorological analysis of CALMET (Cell Ref 5348)

7.2.2 Dispersion modelling

Air dispersion modelling of the key air emission sources was conducted to predict the potential air quality impacts in the surrounding environment.

The modelled odour emissions are based on the proposed remediation methodology for the Project and are represented by a series of area and volume sources. **Figure 7-4** outlines the remediation areas, and two indicative source locations which represent potential worst-case operating locations in terms potential to impact on the closest sensitive receptor locations.

The modelling was conducted for the two remediation areas (Northern and Southern), the average odour emission rate from the area and also the maximum measured odour emission rates were considered in the modelling.

It was assumed that the odour is emitted from a 400m^2 (20m x 20m) area source representing the active working area and barge, a volume source approximately 13m x 8m x 8m high representing the working excavator on a barge and another volume source representing the barge at the staging area. This is conservative as only approximately 2.5m^2 of odorous sediment material surface area would be exposed to the air at any one time.

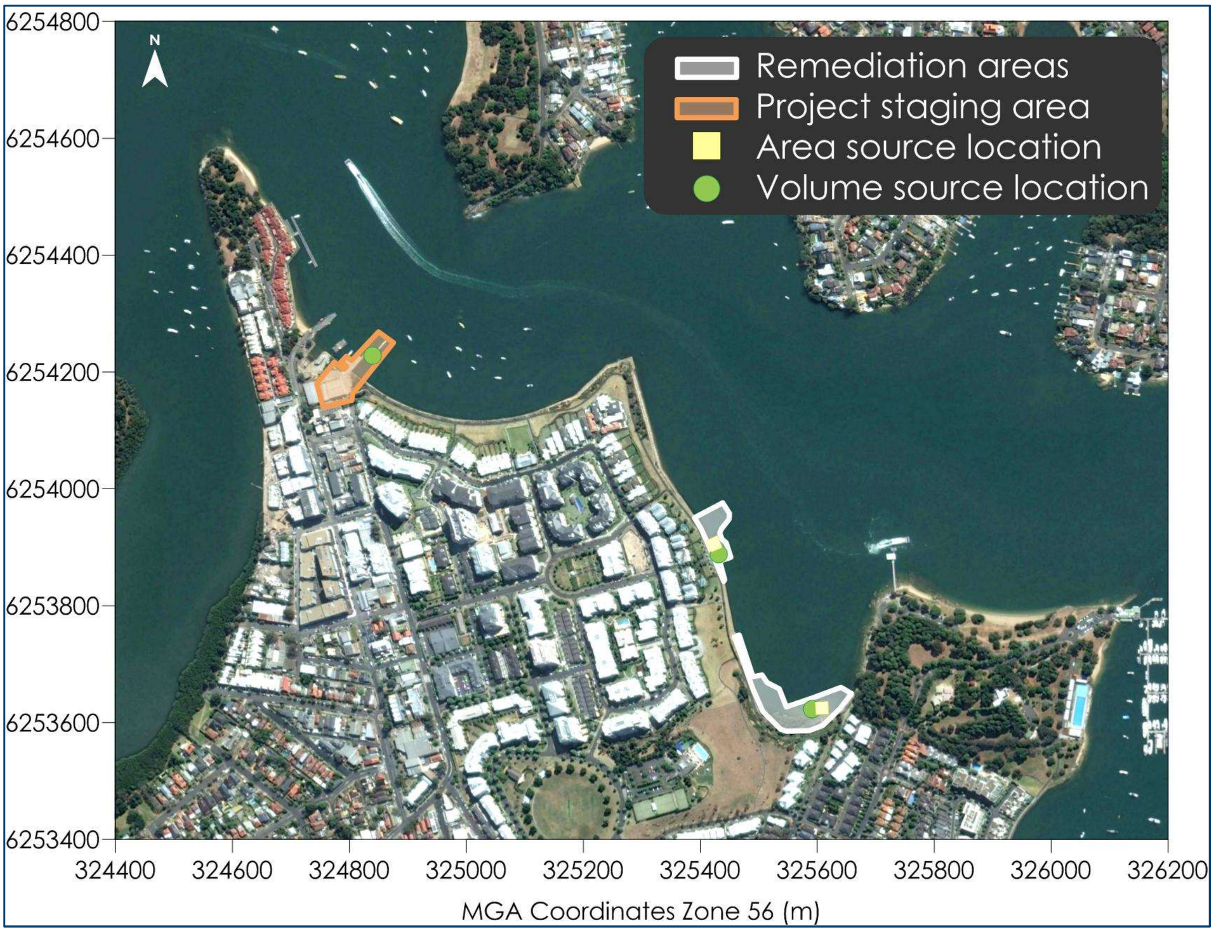

Figure 7-4: Modelled source locations

7.3 Emission estimation

7.3.1 Odour emissions

The odour emission rates for the Project were estimated on the basis of measured odour data and consideration of the proposed remediation methodology.

Odour may emanate from a number of sources including; the excavation of the material from the bay, the volatilisation from the exposed material excavated, from any soiling of the work area, and from the equipment at the staging area.

A summary of the odour emissions applied in the dispersion modelling is shown in **Table 7-1**. The barge at the staging area is assumed to have an emission rate of equivalent to 10% of the working excavator on a barge.

Table 7-1: Summary odour emissions applied in modelling scenarios

Area	Source	Maximum level	Average level	Units
Southern	Working area	0.1	0.1	$OU.m^3/m^2/s$
	Excavator and barge	926	255	OUV/s
	Barge at staging area	93	26	OUV/s
Northern	Working area	0.3	0.2	$OU.m^3/m^2/s$
	Excavator and barge	926	255	OUV/s
	Barge at staging area	93	26	OUV/s

7.3.2 Other pollutants

For the other pollutants, emission rates were estimated using a mass balance calculation based on the measured concentration of the pollutant in the sediment soil.

The remediation methodology involves the excavating of the sediment material and placing it in bins on the barge. The excavated material has a bulk density of 1.4 tonnes per cubic metre. Each bin is to be filled to a capacity of approximately $2m^3$ and each bin is sealed as soon as it is filled. An example calculation for Benzene is set out as follows:

The measured level of Benzene in the sediment is 0.79mg/kg, there is up to 2,800 kg of sediment available to be exposed to the air at any one time ($1.4t/m^3$ x $2m^3$).

The barge holds up to 8 bins but only one is open at any one time, and no more than one barge load can be made in an hour. (i.e. there is only ever up to one open bin for up to approximately an hour).

It is assumed that all the pollutant present in the sediment soil would be released into the surrounding air over the one hour period of handling (or alternatively that each bin releases 1/8 of all of the pollutant in the sediment in approximately 6 minutes of time that the bin is being filled and is not sealed).

Thus the available amount of benzene that can be released is 0.79mg/kg x 2,800kg = 2.2g/hr, or 6.1E-04g/s.

Table 7-2 presents the estimated emission rate for the other pollutants, calculated per the same approach.

Table 7-2: Estimated emission rates for the other pollutants

Pollutant	Estimated emission rate (g/s)
Benzene	6.1E-04
Toluene	1.1E-03
Ethyl Benzene	1.1E-03
m, p - Xylene	2.1E-03
o - Xylene	1.3E-03

8 DISPERSION MODELLING RESULTS

8.1 Odour

The spatial distribution of the dispersion modelling predictions for the worst case modelled odour sources are presented as isopleth diagrams showing the 99th percentile nose-response ground level odour concentrations.

Figure 8-1 and **Figure 8-2** show the predicted odour levels for the Southern Remediation Area for the maximum and average scenarios, respectively. **Figure 8-3** and **Figure 8-4** show the predicted odour levels for the Northern Remediation Area for the maximum and average scenarios, respectively.

Table 8-1 presents the discrete dispersion modelling results at each of the assessed sensitive receptor locations.

The results indicate that odour levels due the Project will be below the applicable criteria at all assessed sensitive receiver locations.

Table 8-1: 99th percentile nose-response average ground level odour concentrations (OU)

Receptor ID	Southern Remediation Area		Northern Remediation Area		Criteria
	Maximum	Average	Maximum	Average	
R1	0.0	0.0	0.0	0.0	2
R2	0.0	0.0	0.0	0.0	2
R3	0.0	0.0	0.1	0.0	2
R4	0.0	0.0	0.0	0.0	2
R5	0.0	0.0	0.0	0.0	2
R6	0.1	0.0	0.3	0.2	2
R7	0.1	0.0	0.4	0.2	2
R8	0.1	0.0	0.7	0.3	2
R9	0.1	0.0	0.9	0.3	2
R10	0.1	0.0	1.0	0.3	2
R11	0.1	0.0	1.2	0.4	2
R12	0.1	0.0	0.4	0.1	2
R13	0.1	0.0	0.3	0.1	2
R14	0.1	0.0	0.2	0.1	2
R15	0.1	0.0	0.1	0.1	2
R16	0.1	0.0	0.1	0.0	2
R17	0.1	0.0	0.1	0.0	2
R18	0.1	0.0	0.1	0.0	2
R19	0.4	0.1	0.1	0.0	2
R20	0.7	0.2	0.1	0.0	2
R21	0.4	0.1	0.1	0.0	2
R22	0.5	0.2	0.1	0.0	2
R23	0.7	0.2	0.1	0.0	2
R24	1.5	0.4	0.1	0.0	2
R25	2.0	0.6	0.2	0.1	2
R26	0.0	0.0	0.0	0.0	2
R27	0.0	0.0	0.1	0.0	2
R28	0.0	0.0	0.0	0.0	2

Figure 8-1: Predicted 99th percentile nose-response average ground level odour concentrations – Southern Remediation Area (Maximum)

Figure 8-2: Predicted 99th percentile nose-response average ground level odour concentrations – Southern Remediation Area (Average)

Figure 8-3: Predicted 99th percentile nose-response average ground level odour concentrations – Northern Remediation Area (Maximum)

Figure 8-4: Predicted 99th percentile nose-response average ground level odour concentrations – Northern Remediation Area (Average)

8.2 Other pollutants

Table 8-2 presents the predicted maximum impact at the worst affected sensitive receptors for each remediation area.

The results indicate the maximum contribution from the Project at the sensitive receptor locations would be below the relevant criteria for each of the assessed pollutants.

Table 8-2: Predicted maximum impact at the worst affected sensitive receptor for other pollutants (µg/m³)

Pollutant	Averaging period	Maximum impact at the most affected receptor		Criteria
		Southern Remediation Area	Northern Remediation Area	
Benzene	1-hour	0.9	0.7	29
Toluene	1-hour	1.7	1.4	360
Ethyl Benzene	1-hour	1.6	1.3	8000
m, p - Xylene	1-hour	3.2	2.5	190
o - Xylene	1-hour	1.9	1.5	190

9 MITIGATION MEASURES

The site observations confirm typical gas work remediation site odours are present in the sediment material. The odour is a chemical, moth-ball-like odour, and was detected on the shore without activity occurring, thus it is certain to be detectable during the remediation process. The measurements and modelling results indicate that the odour levels would be within the EPA criteria, but it is important to observe that even though this odour will be detectable, the levels would be well below levels that may cause health impacts.

Thus the above is an important message to provide to the community prior to and during the remediation activity, i.e. the chemical, moth-ball like odour will be detectable but will not occur at harmful levels. Obviously it is best to remediate this contamination, cleaning up the bay for future generations, and in the interim there will be some odour generated during the remediation process.

To adequately control the potential odour, it is necessary to put in place mitigation measures during remediation activities. Potential measures to consider include the following:

- Limiting remediation activity to daytime hours.
- Limiting remediation activity on the contamination "hotspot" area to periods when the wind blows from the western quadrant (on a case by case basis if necessary).
- Only excavating/ exposing the minimum area of sediment material necessary at any one time.
- Covering each bin of excavated material immediately once filled.
- Minimising the drop height of the excavator (i.e. limiting the height through which material is dropped into the bin).
- Regularly (e.g. daily or per shift) cleaning of the excavator arm and any surfaces soiled with potentially odorous material.
- Washing outside of bins at berth prior to loading from the barge to remove any material on the surface of the bins.
- A plan for complaints management that includes a provision for a staff member or other person that is not regularly on site to come to the site at short notice to investigate any odour complaint.

10 SUMMARY AND CONCLUSIONS

This report has assessed the potential worst-case air quality impacts associated with the proposed remediation of Kendall Bay.

Air dispersion modelling using the CALPUFF model was used to predict the potential for off-site air quality impacts in the surrounding area due to proposed activity at the Project. The modelling applies estimated pollutant emission rates with local sources of meteorological data.

The results show that the predicted impacts from the proposed operations are low and would be within the relevant air quality criterion for each of the assessable air pollutants at the assessed sensitive receptor locations.

Overall, the assessment demonstrates that the Project can operate without causing any significant air quality impact at sensitive receptor locations in the surrounding environment at any time.

However, as is common with gas-works remediation sites, the odour that will be generated is a chemical, moth-ball like odour. This odour will be detectable, but will not occur at harmful levels. This is a very important message to communicate to the potential nearby receptors prior to and during the remediation process.

11 REFERENCES

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Appendix A

Sensitive Receptor Locations

Figure A-1: Location of sensitive receptors assessed in this study

Appendix B
Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of five years of meteorological data from the Sydney Olympic Park weather station is presented in **Table B-1**. The standard deviation of the five years of meteorological data spanning 2012 to 2017 was analysed against the long term average mean measured wind speed, temperature and relative humidity.

The analysis indicates that 2012 is closest to the average for wind speed, temperature and for relative humidity.

Figure B-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity of the 2012 year compared with the mean of the latest five years data set. The 2012 year data appears to be well aligned with the mean data.

Therefore, based on this analysis it was determined that 2012 is generally representative of the long-term trends compared to other years and is thus suitable for the purpose of modelling.

Table B-1: Statistical analysis of meteorological data from Bankstown Airport AWS

Year	Wind speed	Temperature	Relative humidity
2012	0.3	0.5	4.1
2013	0.3	0.8	4.8
2014	0.3	0.7	6.0
2015	0.4	0.8	4.7
2016	0.4	0.9	4.3

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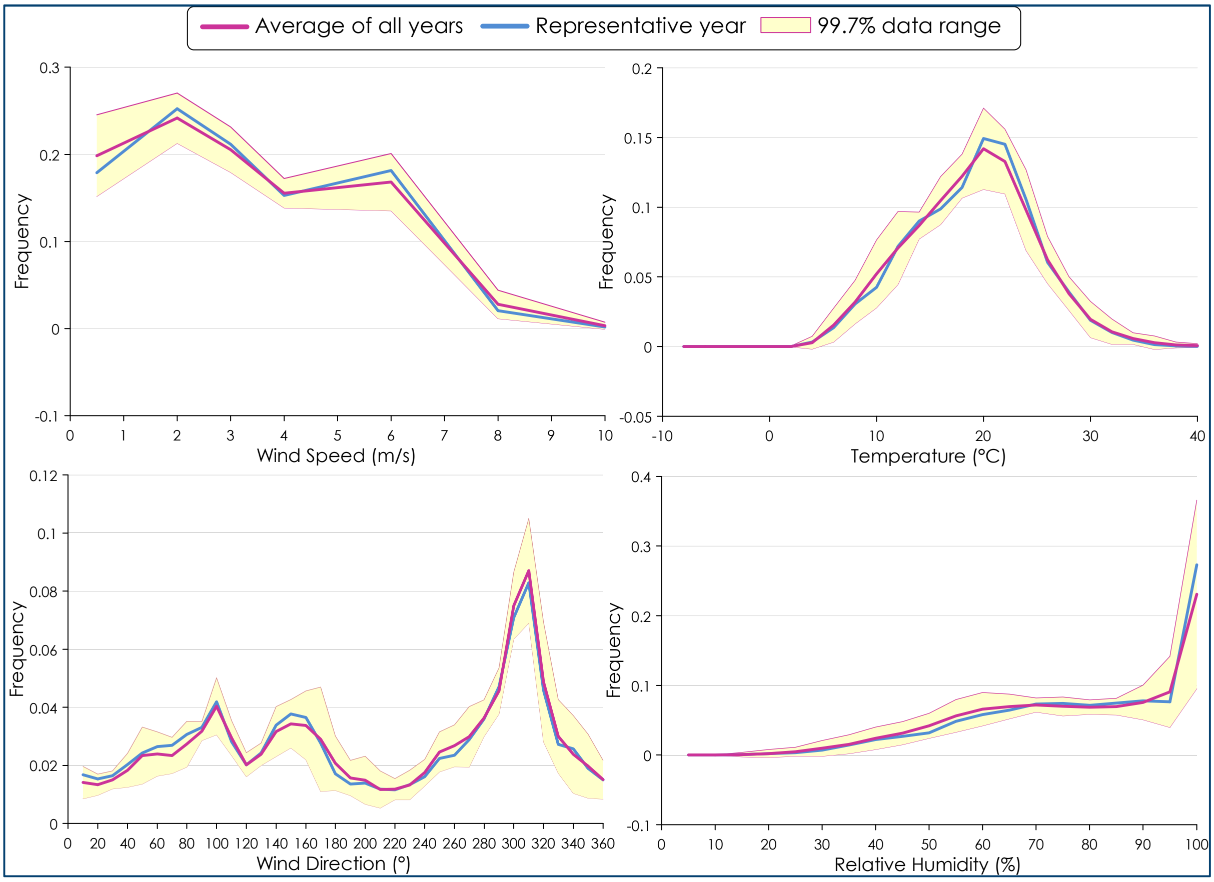

Figure B-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity