REPORT

PATONS LANE RESOURCE RECOVERY FACILITY – INTEGRATED WATER AND LEACHATE PLANT MODIFICATIONS

123-179 PATONS LANE, ORCHARD HILLS, NSW

AIR QUALITY IMPACT ASSESSMENT
RWDI # 2205770
December 16, 2022

SUBMITTED TO

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NOTE

WILKINSON MURRAY

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RWDI

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TABLE OF CONTENTS

LIST OF APPENDICES

EXECUTIVE SUMMARY

This Air Quality Impact Assessment report has been prepared by RWDI Australia Pty Ltd for Jackson Environment and Planning Pty Ltd (JEP) on behalf of Bingo Industries Limited (Bingo) to accompany a detailed State Significant Development (SSD), Development Application (DA) for the proposed Integrated water and Leachate Plant modifications for Patons Lane Resource Recovery facility (the Proposal site) located at 123-179 Patons Lane, Orchard Hills, NS (Lot 40, DP 738126) within the former Erskine Park Quarry owned by SRC Properties Pty Ltd (a wholly owned subsidiary of Bingo Industries).

The report has been prepared to address the air quality and odour requirements of the Department of Planning and Environment Assessment Advice with respect to the proposed modification. The report assessed the potential Construction and Operational dust and odour impacts associated with the proposed Integrated water and Leachate Plant modifications in general accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2022).

A risk-based approach was adopted to assess dust emissions from the construction of the proposed modifications in accordance with the Guidance on the Assessment of Dust from Demolition and Construction by the Institute of Air Quality Management in the United Kingdom (IAQM, 2014) . The assessment concluded that there would be a low risk of dust impacts from construction and with the implementation of recommended mitigation measures, no significant air quality impacts are expected to occur during the construction of the proposed modifications.

A quantitative approach was adopted to assess air quality impacts on nearby receptors during the operation of the Project. The results of the dispersion modelling indicate that dust and odour concentrations due to the worst-case operation of the proposed modifications would comply with the established criteria at all sensitive receptors. Therefore, there would be no adverse air quality impacts associated with the operation of the proposed modifications.

1 INTRODUCTION

1.1 Overview

RWDI has been engaged by Jackson Environment and Planning Pty Ltd (JEP) on behalf of SRC Properties Pty Ltd (a wholly owned subsidiary of Bingo Industries Limited) to conduct an air quality impact study for the proposed Integrated water and Leachate Plant modifications for Patons Lane Resource Recovery facility.

The PLRRC operates under a State Significant Development approval (MP09_0074) as a resource recovery centre and landfill for commercial and industrial (C&I) and construction and demolition (C&D) wastes (non-putrescible general solid waste). Since the existing approval was granted for the Facility by the NSW Land and Environment Court, there has been changes to market conditions, Bingo's broader network operations and the NSW waste management regulatory framework. These changes have highlighted the need for Bingo to adjust site operations at the Facility.

The following modifications (MOD2) to the site are currently being considered as part of a Statement of Environmental Effects to accompany a Development Application for Bingo's Patons Lane Resource Recovery Centre (PLRRC) under s4.55(1a) of the Environmental Planning and Assessment Act 1979:

- Recycling Water Treatment Plant (RWTP) infrastructure to support the resource recovery centre;
- Landfill Leachate Treatment Plant (LTP); and
- Additional new raw leachate dam and new contact water dam; and
- A future connection to sewer and potable water

Given that the impacts of the proposed integrated water and leachate plant modifications are likely to be minor (and in most cases positive), development consent under s4.55(1a) of the Environmental Planning and Assessment Act 1979 is considered appropriate. This has been confirmed in consultation with the Department of Planning and Environment.

1.2 Objectives

The purpose of this assessment is to document the process, objectives, and outcomes of the air quality impact assessment to support the development application for Bingo's PLRRC modifications.

The air quality assessment has the following main components:

- Existing Environment;
- Land zoning of the site and neighbouring area;
- Identifying the sensitive receivers for the air quality impact assessment;
- Establishing the target criteria at sensitive receivers for:
  - Environmental Protection Authority (EPA) guideline entitled "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2022)"
- Preparation of a computer-based air quality model representative of the proposed worst-case operations;

- Determination of the potential impacts of air quality emissions associated with construction and operation air quality impacts from the site upon nearby receivers;
- Providing recommendations to ensure operations and construction activities do not result in any adverse air quality impacts upon the surrounding community

2 DATA AND METHODS

2.1 Site Description, Land-Use and Sensitive Receptors

The PLRRC is situated north of Patons Lane approximately 3km south of the M4 Motorway in western Sydney. The Project Site is approximately 3km to the west of St Clair and Erskine Park and approximately 6km north of Badgerys Creek. Access to the site is via Patons Lane which extends to the west off Luddenham Road.

The land use immediately surrounding the site is largely rural/rural-residential in character comprising a mix of open grazing land, vegetated areas, and residential development. Immediately to the north and east of the site are rural properties (including "Roughwood Park" and "Glenholme Farm") containing residences and out-buildings with similar land holdings further to the north-east and south-east of the site. Approximately 500 m further north of the site is a residential subdivision known as the "The Vines" containing large, detached residences. "The Vines" were approved by Penrith Council on 4 July 1988 after the quarry on the project site was in existence. Further to the south-east are rural-residential properties with frontage to Luddenham Road. Adjoining to the west and south of the site is heavily vegetated land owned by the Commonwealth which is used by the Australian Defence Force. The locations of all nearby sensitive receptors are identified in Table 2-1 and shown in Figure 2-1.

Table 2-1: Sensitive Receptors

Receptor	Address	Coordinates (MGA 56)	
		X	Y
A	43A Luddenham Rd, Orchard Hills NSW 2748	292128	6256877
B	117-199 Luddenham Rd, Orchard Hills NSW 2748	292184	6256497
C	211-227 Luddenham Rd, Orchard Hills NSW 2748	292594	6255586
D	229-231 Luddenham Rd, Orchard Hills NSW 2748	292484	6255422
E	233-249 Luddenham Rd, Orchard Hills NSW 2748	292672	6255354
F	251-261 Luddenham Rd, Orchard Hills NSW 2748	292602	6255279
G	275-285 Luddenham Rd, Orchard Hills NSW 2748	292610	6255090
H	268-288 Luddenham Rd, Orchard Hills NSW 2748	292816	6255016
I	262-266 Luddenham Rd, Orchard Hills NSW 2748	292823	6255204
J	256 Luddenham Rd, Orchard Hills NSW 2748	292829	6255252
K	250-254 Luddenham Rd, Orchard Hills NSW 2748	292833	6255307
L	246-248 Luddenham Rd, Orchard Hills NSW 2748	292805	6255356
M	240-244 Luddenham Rd, Orchard Hills NSW 2748	292803	6255409
N	236-238 Luddenham Rd, Orchard Hills NSW 2748	292785	6255459
O	230-234 Luddenham Rd, Orchard Hills NSW 2748	292777	6255505

Receptor	Address	Coordinates (MGA 56)	
		X	Y
P	226-228 Luddenham Rd, Orchard Hills NSW 2748	292770	6255551
Q	222-224 Luddenham Rd, Orchard Hills NSW 2748	292770	6255598
R	216 Luddenham Rd, Orchard Hills NSW 2748	292768	6255645
S	212-214 Luddenham Rd, Orchard Hills NSW 2748	292754	6255690
T	202-210 Luddenham Rd, Orchard Hills NSW 2748	292746	6255743
U	22 Verdelho Way, Orchard Hills NSW 2748	291025	6257911
V	3 Chablis Pl, Orchard Hills NSW 2748	290968	6257412
W	15 Cabernet Circuit, Orchard Hills NSW 2748	291254	6257366
X	10 Bordeaux Pl, Orchard Hills NSW 2748	291525	6257501

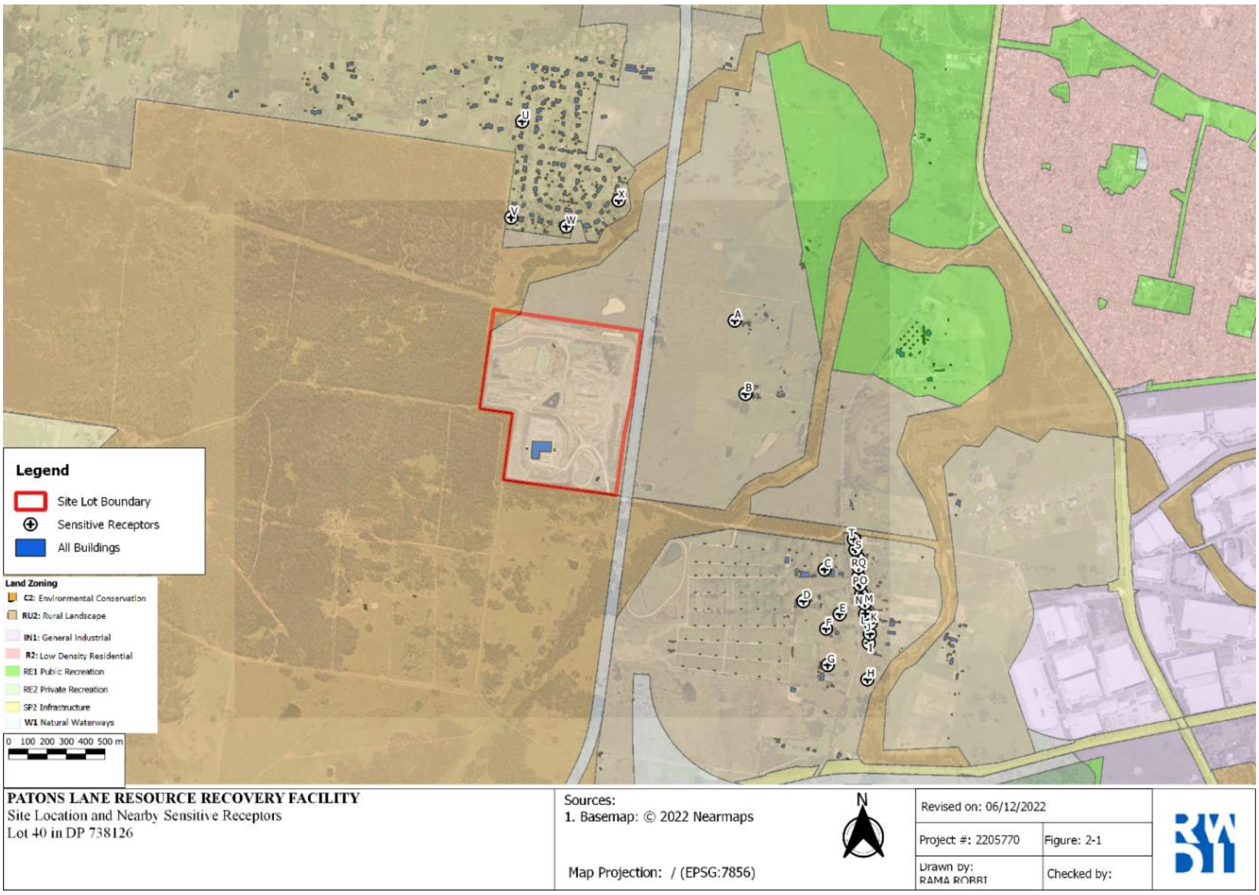


Figure 2-1: Site Location and Nearby Sensitive Receptors

2.2 Background

The Facility was originally approved under Part 3A (now repealed) of the Environmental Planning and Assessment Act 1979 (EP&A Act). The PLRRC operates under a State Significant Development approval (MP09_0074) granted in August 2012 by the Land and Environment Court, as a resource recovery centre (RRC) and landfill for commercial and industrial (C&I) and construction and demolition (C&D) wastes (non-putrescible general solid waste):

- Landfilling activities within a total void space of 4.3 million tonnes;
- Acceptance of up to 450,000 tonnes per annum (tpa) of C&D and C&I waste with
- 350,000 tpa of resource recovery and landfilling of up to 205,000 tpa;
- Resource recovery activities within the Recycling and Reprocessing Area (RRA);
- Clay / shale extraction; and
- Ancillary infrastructure.

The Approval was subsequently modified (MOD 1) in March 2016 to allow for changes to site establishment activities. MOD 1 was essentially an administrative modification to provide appropriate contingencies for site establishment program.

Site establishment works commenced on 19 April 2018 with the majority of works completed in April 2019. Operation of the site commenced in August 2019. Environmental Protection Licences for landfill and resource recovery centre were issued by the Environment Protection Authority in June and July 2019, respectively. Since commencing operations in August 2019, the site has only received waste intermittently at both the landfill and RRC. The landfill is not currently operational and is forecast to recommence by July 2023. The RRC to date has been operating with a focus on processing recovered aggregates (<60mm) sourced from Bingo's network of transfer stations and recycling facilities. There are no outstanding EPL compliance issues for the RRC (EPL 21259) or the landfill (EPL 20814).

2.3 Proposed Modifications

Since the existing approval was granted for the Facility by the NSW Land and Environment Court, there has been changes to market conditions, Bingo's broader network operations and the NSW waste management regulatory framework. These changes have highlighted the need for Bingo to adjust site operations at the Facility.

This Modification Proposal aims to improve the quality of recovered soils from processing of building waste, to protect human health and the environment. This plant and investment will help Bingo improve the quality of recovered soils and aggregates, increase diversion rates, and better deliver on the objectives of the NSW Government's *Waste and Sustainable Materials Strategy 2041: Stage 1 – 2021-2027*. NSW currently has an under-supply of processing capacity for general solid waste resource recovery; therefore, the modified development will provide additional processing capacity to ensure more wastes are recovered and re-used and less are sent to landfill.

The proposed elements of the integrated water treatment management system upgrades would include an additional new raw leachate dam, new contact water dam, Leachate Treatment Plant (LTP), Recycling Water Treatment Plant (RWTP) infrastructure to support the resource recovery centre, and a future connection to sewer and potable water.

The RWTP would assist in removing silt loads within process water from the resource recovery centre enabling reuse of this water in the system. This upgrade to the RWTP is required to ensure adequate treatment of wash water for reuse in an NSW EPA approved resource recovery trial. The trial will identify if the Facility's processes are suitable to accept and treat materials classified as general solid waste (GSW). The upgrades to the RWTP and water reuse would allow additional resource recovery of aggregates, sands, ferrous and non-ferrous metals that would otherwise be lost to landfill. The proposed plant and equipment investment by SRC would improve the quality and quantity of recovered soils, increase landfill diversion rates, and assist in delivering the objectives of the NSW Government's *Waste and Sustainable Materials Strategy 2041: Stage 1 – 2021-2027*.

The Modification Proposal also seeks to upgrade the landfill leachate treatment system to achieve improved water quality outcomes related to the landfill. Provision of a leachate treatment plant would improve the reliability and efficacy of the leachate management system, bringing the site in line with modern best practice and improving environmental outcomes.

The upgrade of water management infrastructure to support the PLRRC and ongoing landfilling operations would not result in changes to the approved types or volumes of waste accepted at the Facility under the existing Project Approval.

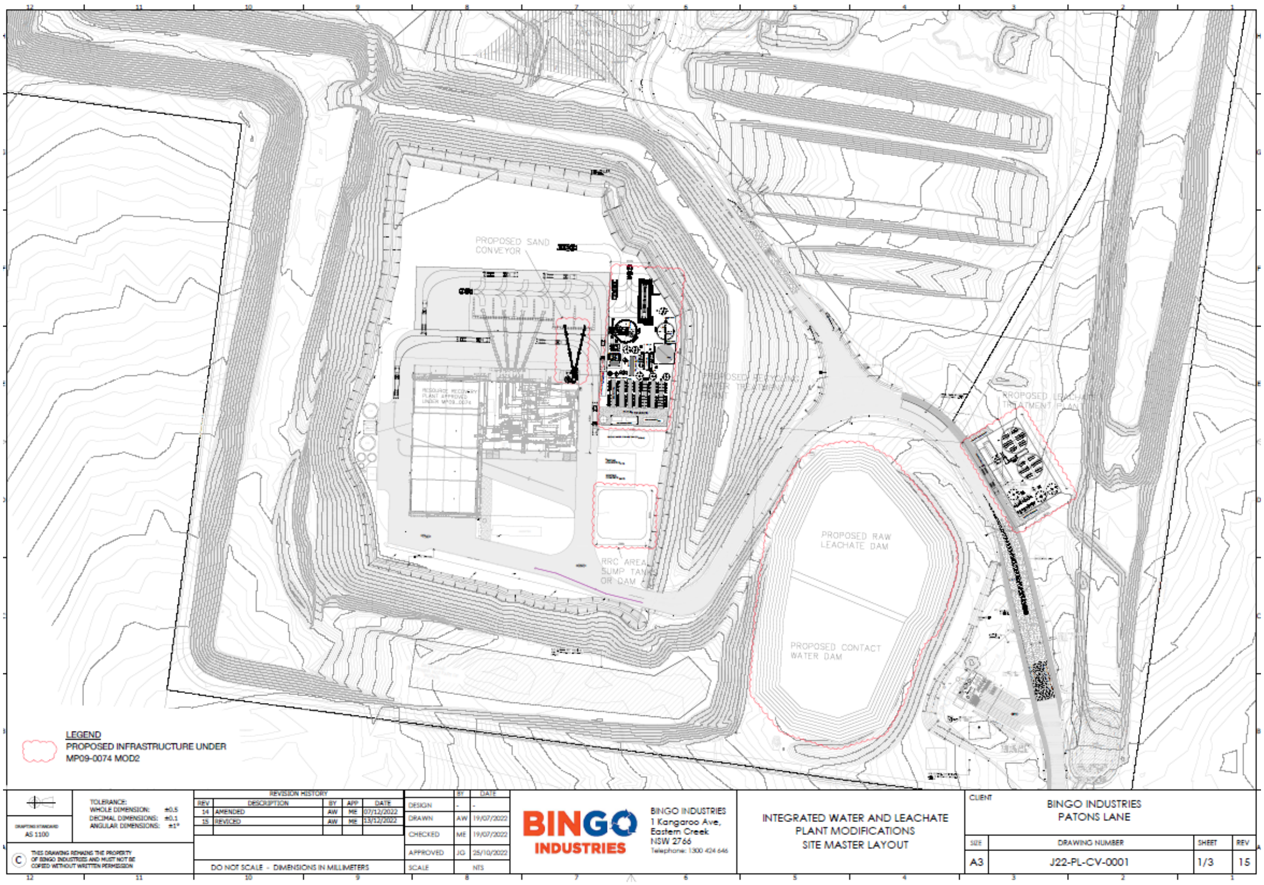


Figure 2-2: Site Master Layout

2.3.1 Proposed Recycling Water Treatment Plant (RWTP)

The RWTP is proposed to be located on the north-east corner of the existing PLRRC buildings and within the confines of the earthen bunds of the PLRRC. Existing dual sand conveyors are considered part of the RWTP and will be regularized as part of this Modification Proposal. The RWTP would allow additional resource recovery of aggregates that would otherwise be lost to landfill. The site layout and conceptual layout of the RWTP are shown in Figure 2-3 and Figure 2-4, respectively. The compound and infrastructure layout are indicative and subject to final contractor requirements and detailed design.

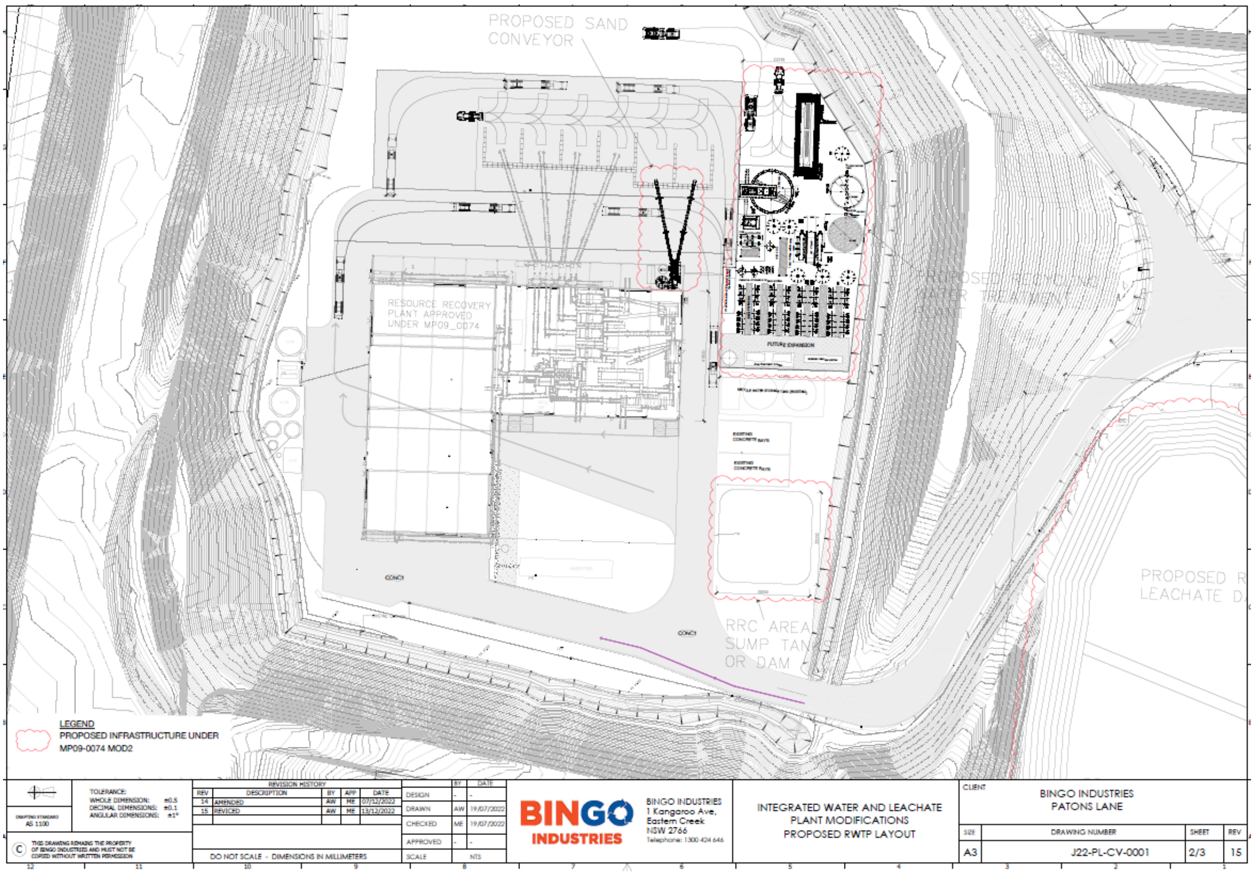


Figure 2-3: The Site Layout of RWTP

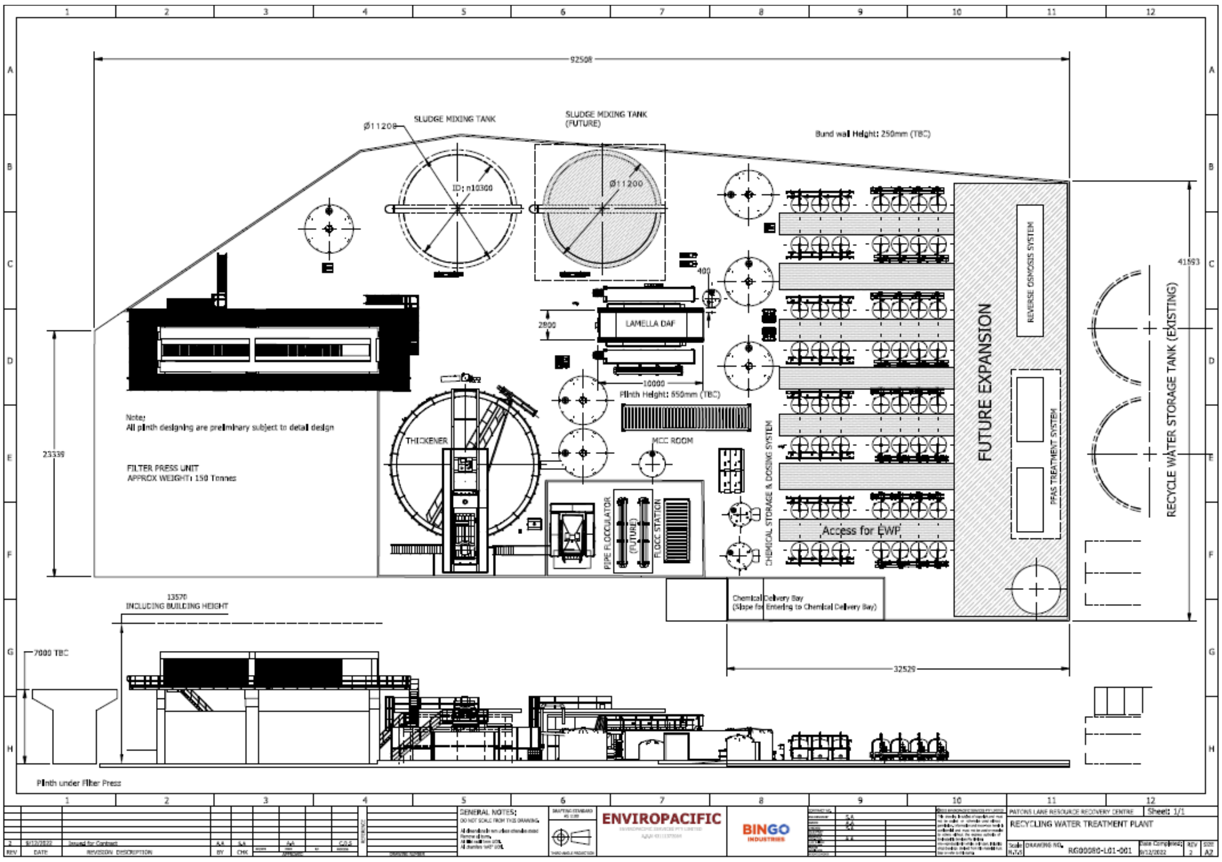


Figure 2-4: The Conceptual Layout of RWTP

2.3.2 **Proposed Landfill Leachate Treatment Plant**

A leachate treatment plant is proposed to manage landfill leachate (from landfill operations only) and the current operational constraints associated with the existing leachate management system. The leachate treatment system is expected to comprise a new raw leachate dam to complement the existing raw leachate dam, a new contact water dam, a leachate treatment plant (with associated filters and chemical dosing systems) and a treated leachate holding tank. The leachate treatment plant will be designed and constructed to treat the influent leachate to a level that meets the standard trade waste acceptance standards set by Sydney Water. The proposed LTP is proposed to be located to the north-east of the proposed raw leachate dam and a potential future sewer connection point near the existing site entrance.

The proposed leachate treatment plant would improve the effectiveness of the Facility's leachate management system and prepare the Site for connection and discharge of surplus treated leachate to sewer subject to a trade waste agreement with Sydney Water.

Currently leachate water is tankered off site. The Modification proposal includes the treatment and tanker of treated leachate water until a sewer connection is provided.

Provision of the LTP would improve the reliability and efficacy of the leachate management system, bringing the site in line with modern best practice and improving environmental outcomes. The proposed site layout and conceptual layout of the LTP is shown in Figure 2-5 and Figure 2-6. The compound and infrastructure layout are indicative and subject to final contractor requirements and detailed design.

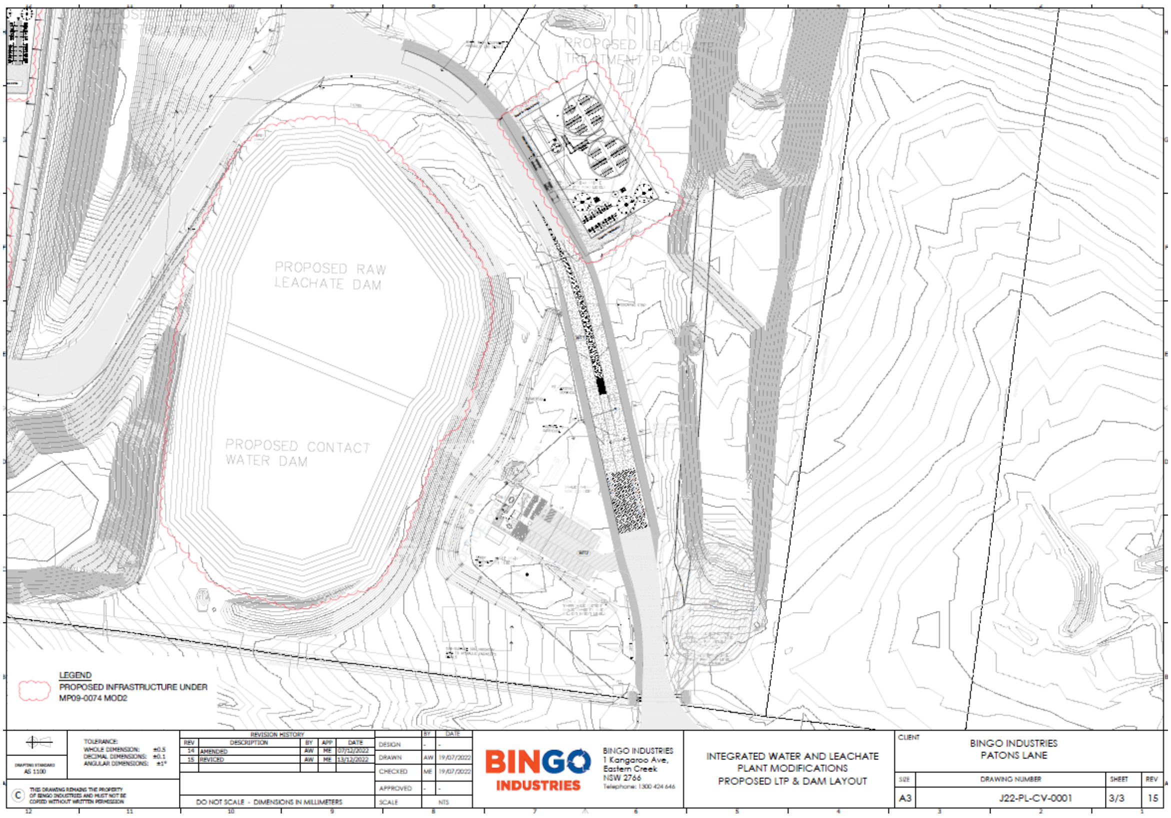


Figure 2-5: The Site Layout of LTP

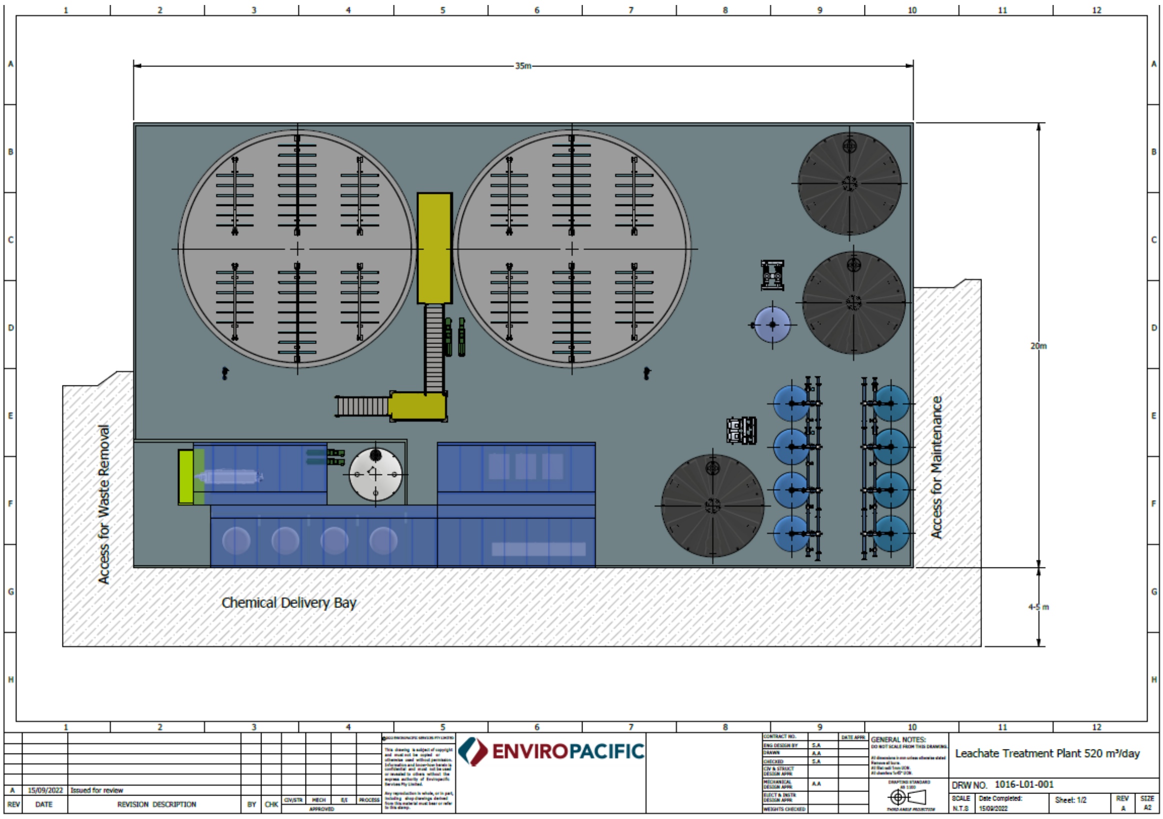


Figure 2-6: The Conceptual Layout of LTP

2.3.3 Operational Hours

The are no changes to the proposed operational hours. Currently, the RRC operates between 7am – 5pm Monday to Friday, and 8am - 2pm Saturday.

Based on the water balance and the abundance of contact water, the LTP would need to run 24/7 due to the high generation volumes and low sewer discharge rate. Hence it is proposed to extend these hours 24/7 for the operation of the LTP.

2.4 Environmental Obligations

The Site was granted an Environment Protection License (EPL) 20814 by NSW EPA on 8 November 2016 to carry out extractive activities and waste disposal.

The conditions relevant to the air quality in the EPL 20814 are as follows:

O3 Dust
O3.1 Activities occurring in or on the premises must be carried out in a manner that prevents or minimises the generation of dust.
O3.2 The premises must be maintained in a condition which prevents or minimises the emission of dust from the premises.
O3.3 The licensee must ensure no visible dust leaves the premises.
O3.4 The licensee must ensure that no material including sediment is tracked from the premises.

Schedule 4 - Specific Environmental Conditions within the Land & Environment Court Proceedings No. 10928 of 2010 prescribes a number of relevant environmental conditions including:

- *Condition 12 – Odour Discharge Limits: The Proponent shall not cause or permit the emission from the site of offensive odours as defined under Section 129 of the POEO Act.*
- *Condition 13 – Dust and Particulate Matter Limits: The Proponent shall ensure that dust and particulates generated by the Project do not exceed the criteria listed in tables 4, 5 and 6 at any residence or on more than 25 percent of any privately owned land surrounding the Site.*

Table 4 - Long term criteria for particulate matter

Pollutant	Averaging Period	Criteria (1,2)
Total Suspended Particulates (TSP)	Annual	90 µg/m^3
Particulate Matter ≤ 10 µm (PM_{10})	Annual	30 µg/m^3

Table 5 - Short term criteria for particulate matter

Pollutant	Averaging Period	Criteria (1,2)
Particulate Matter ≤ 10 µm (PM_{10})	24 Hour	50 µg/m^3

Table 6 - Long term criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level (3)	Maximum total deposited dust level (2)
Deposited Dust (4)	Annual	2 $g/m^2/month$	a4 $g/m^2/month$

Notes: (1) Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed to by the Director-General in consultation with EPA.

(2) Total impact (i.e., incremental increase in concentrations due to the Project plus background concentrations due to other sources).

(3) Incremental impact (i.e., incremental increase in concentrations due to the Project on its own).

(4) Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.

- *Condition 14 and 15 – Dust and Particulate Matter Management: The facility employs all feasible and practicable measures to minimise any visible dust emissions from the site.*
- *Condition 16 – Air Quality and Greenhouse Gas Management Plan. This condition has been addressed in the Patons Lane Resource Recovery Centre Air Quality and Greenhouse Management Plan (2019 Todoroski).*

The site was also granted another EPL, 21259 by NSW EPA for the Resource Recovery Facility. However there are no site-specific dust monitoring requirements for this EPL. Considering that the air quality limits specified in the condition O3 of EPL 20814 and also the conditions of consent No. 13 prescribed within appeal no 10928 of 2010 are based on background air quality levels conducted more than 10 years ago (i.e., June 2009 and July 2011), it is proposed to consider updated air quality criteria based on recent air quality levels measured in 2018. The air quality criteria for the Site operations with the proposed modification are discussed in section 2.5

2.5 Air Quality Criteria

2.5.1 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods - 2022) provides applicable impact assessment criteria for several air pollutants. Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to ambient air quality. The sections below identify the pollutants of interest in this study and the applicable impact assessment criteria.

2.5.2 Pollutants of Interest

Dust, Odour, and particulate matter are the major air pollutants associated with the Proposal. Specifically, the following pollutants are identified:

- Dust, specifically:
  - fine and coarse particulate matter ($PM_{2.5}$ and PM_{10});
  - total suspended particulates (TSP); and,
  - deposited dust;
- Odour.

2.5.3 Dust Impact Assessment Criteria

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. Table 2-2 list the air quality criteria for the pollutants of interest in this study. These criteria are consistent with the National Environment Protection Council's (NEPC), National Environment Protection (Ambient Air Quality) Measure, 2021 (NEPM). For air quality criteria relate to the total impact, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 2-2: Impact Assessment Criteria – Dust and Particulate Matter

Pollutant	Averaging Period	Impact (1)	Criteria
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	24-hours	Total	25 µg/m^3
	Annual	Total	8 µg/m^3
Particulate Matter ≤ 10 µm (PM_{10})	24-hours	Total	50 µg/m^3
	Annual	Total	25 µg/m^3
Total Suspended Particulates (TSP)	Annual	Total	90 µg/m^3
Deposited Dust	Annual	Incremental	2 g/m^2/month
	Annual	Total	4 g/m^2/month

Note: (1) For air quality criteria related to the total impact, project contributions and background levels need to be considered. Incremental impacts are from project only.

2.5.4 Odour Assessment Criteria

Odours from the proposed modifications have the potential to cause nuisance. In a regulatory context, odour needs to be considered in two ways, depending on the situation. NSW legislation 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 unreasonably interfere with the comfort and repose of the normal person. 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 a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. Therefore, there can be a wide range of variability in the way odour response is interpreted.

It should be noted that 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 odorous pollutants, or more simply odour. For developments with potential for odour it may be necessary to predict the likely odour impact that 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 it 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 in

Table 2-3 for complex mixtures of odorous pollutants.

Table 2-3 : Impact assessment criteria – Complex Mixture of Odourous Pollutants

Population of affected community	Impact assessment criteria (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

Note: * 99th percentile nose-response time.

The land use immediately surrounding the site is largely rural/rural-residential. Therefore, in accordance with the criteria in Table 2-3, an impact assessment criterion of **7.0 OU** was selected.

2.6 Existing Environment

Meteorological conditions strongly influence air quality. Most significantly, wind speed, wind direction, temperature, relative humidity, and rainfall affect the dispersion of air pollutants and are key inputs into dispersion models. The following sub-sections discuss the local meteorology near the Proposal site and identify a representative set of meteorological data for use in the dispersion modelling to be undertaken for this assessment.

2.6.1 Long-Term Climate

Long-term meteorological data for the area surrounding the Proposal site is available from the Badgerys Creek AWS BOM weather station (067108). The Badgerys Creek AWS is located at the Proposal site and records observations of meteorological data including wind speed, wind direction, temperature, and rainfall.

Long-term climate statistics are presented in Table 2-4. Temperature data recorded at the Badgerys Creek AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 29.8°C. July is the coolest month with a mean daily minimum temperature of 4.1°C. February is the wettest month with an average rainfall of 100.0 mm.

Table 2-4: Long-term Climate Averages, Badgerys Creek AWS

Obs.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean Minimum and Maximum Temperature													
Min (°C)	17.0	17.1	15.1	11.4	7.7	5.5	4.1	4.7	7.7	10.4	13.5	17.1	10.8
Max (°C)	29.8	28.6	26.8	23.9	20.7	17.8	17.3	19.2	22.6	24.9	26.3	28.2	23.8
Mean Rainfall													
Rain (mm)	84.4	100.0	74.1	52.1	39.4	62.0	24.7	37.5	32.7	53.0	74.1	60.6	57.0
Mean 9AM Wind Speed													
Wind Speed (m/s)	1.8	1.9	1.7	1.8	1.1	1.4	1.5	1.4	1.2	1.7	2.4	1.3	1.6

2.6.2 Wind

The dispersion of dust and odour emissions is primary influenced by the following meteorological factors:

- wind speed and direction;
- wind profile and turbulence intensity (which are affected by terrain);
- temperature gradient which affects atmospheric stability and is determined from wind speed, cloud cover and solar radiation;
- mixing height, which is the depth of the atmospheric boundary layer, where most of the dispersion occurs.

Wind speed and atmospheric stability are examined with respect to flow direction to investigate typical flow regimes and directions of poor dispersion.

Appendix A provides detailed information regarding the meteorological modelling assessment for this project. The wind rose plots in Appendix A show that winds in the study area most frequently blow towards the southwestern quadrants. Wind speed and wind direction during 2018 are generally representative of the five-year period and have therefore been adopted for modelling purposes.

2.6.3 Local Ambient Air Quality

Existing concentrations of dust and particulate matter are taken from the nearest air quality monitoring station (AQMS), which is the St. Mary's monitoring station approximately 2 km northeast of the Proposal site. A summary of the $PM_{2.5}$ and PM_{10} monitoring result collected at the St. Mary's AQMS during the modelling year (2018) is presented in Table 2-5.

Table 2-5: 2018 Particulate Matter Monitoring Results – St. Mary's AQMS

Statistic	St. Mary's AQMS	
	$PM_{2.5}$	PM_{10}
24-hour average, max	82.5	100.5
24-hour average, max complying (1)	23.2	47.6
24-hour average, 99th percentile max complying (1)	23.0	47.1
24-hour average, 95th percentile max complying (1)	22.7	46.7
24-hour average exceedances	3	2
Annual average	7.7	19.4

Note: (1) Highest values less than the EPA impact assessment criteria

The data in Table 2-5 show that ambient 24-hour average $PM_{2.5}$ and PM_{10} concentrations at St. Mary's AQMS exceeded the goals of 25 µg/m^3 and 50 µg/m^3 several times. As noted in the NSW Annual Air Quality Statement 2018, particle pollution was elevated in 2018 due to "… more frequent exceptional events, such as dust storms, bushfires, and hazard reduction burns."

There are no readily available site specific Total Suspended Particulates (TSP) and deposited dust monitoring data. The St. Mary's monitoring site does not measure these components; however, estimates of the background levels for the area are required to assess the impacts of the Proposal on TSP and deposited dust.

Estimates of the annual average background TSP concentrations can be determined from a relationship between measured PM_{10} concentrations. This relationship assumes that 40% of the TSP is PM_{10} and was established as part of a review of ambient monitoring data collected by co-located TSP and PM_{10} monitors operated for reasonably long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Applying this relationship to the 2018 annual average PM_{10} concentration of 19.4 µg/m^3 at the St. Mary's AQMS yields an estimated annual average TSP concentration of 48.4 µg/m^3.

To estimate annual average dust deposition levels, a similar process to the method used to estimate TSP concentrations is applied. This approach assumes that a TSP concentration of 90 µg/m^3 will have an equivalent dust deposition value of 4 g/m^2/month; and indicates a background annual average dust deposition of 2.15 g/m^2/month for the area surrounding the Proposal.

Table 2-6 summarises the background air quality adopted for assessment purposes. For 24-hour average $PM_{2.5}$ and PM_{10}, contemporaneous (Level 2) assessments have been conducted whereby the measured ambient concentrations at the St. Mary's AQMS are added to the dispersion model results for each day of the simulation.

Table 2-6: Background Air Quality Adopted for Assessment

Pollutant	Averaging Period	Adopted Background Concentration/Level
$PM_{2.5}$	24-hours	Contemporaneous
	Annual	7.7
PM_{10}	24-hours	Contemporaneous
	Annual	19.4
TSP	Annual	48.4
Deposited Dust	Annual	2.15

2.7 Potential Sources of Air Emissions

Air emissions are likely during both the construction and the operation of the proposed integrated water management system. The most likely air quality sources for construction and operation are summarised in the following sections.

2.7.1 Construction Phase

At the time of preparing this assessment a detailed construction programme has not been developed, however the following stages and typical activities can be expected. A summary of potential construction emissions is provided below:

- Minor dust emissions from staging works
- Dust emissions from earthworks and civil works
- Minor Exhaust emissions from vehicles and equipment's
- Minor dust emissions from the construction of structure

Excavation is the only construction stage with potential to release dust emissions. Minor dust emission (non-significant quantities) is expected from all other construction stages.

2.7.2 Operation Phase

The significant sources of dust/particulate emissions associated with the operation of the proposed modification are identified as:

- Loading, Unloading, Screening and Processing material;
- Truck movements on paved and unpaved roads;
- Wind Erosion emissions

The significant sources of Odour associated with the operation of the proposed modification are identified below:

- Odour form the RWTP and LTP

- Odour from the Proposed Leachate Dam

A detailed emissions inventory for dust and odour are provided in Appendix B.

2.8 Modelling Approaches

2.8.1 Construction Dust Assessment

The approach taken for the assessment of dust impacts associated with the construction of the proposed modification is as follows:

1. A qualitative assessment method is considered appropriate for this project
2. The assessment follows the Guidance on the Assessment of Dust from Demolition and Construction published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014)

This approach has been widely used for performing qualitative assessments of dust emissions from construction sites and has been used in NSW by RWDI and other consultants.

This approach presents the risk of dust soiling and human health impacts associated with four types of activities that occur on construction sites (demolition, earthworks, construction and trackout) and involves the following steps:

- Step 1: Screen the need for a detailed assessment;
- Step 2: Assess the risk of dust impacts arising, based on:
    - The potential magnitude of dust emissions from the works; and
    - The sensitivity of the surrounding area.
- Step 3: Identify site-specific mitigation; and
- Step 4: Consider the significance of residual impacts, after the implementation of mitigation measures.

For this project, the process outlined above will be applied to the worst-case on-site and off-site activities that are likely to result in the highest generation of dust. This approach will result in a conservative assessment of the potential risks for human health and dust soiling impacts.

2.8.2 Operational Dust Assessment

The approach taken for the operational dust assessment is as follows:

1. Scenario A - Estimate annual dust emissions of each activity associated with worst case scenario of the previously approved operations as per 2012 approval by PAE Holmes (scenario 3b)
2. Scenario B – This is a combination of Scenario A and the dust emissions from the proposed modifications which are mainly from the screening process and sand conveyor systems.
3. Provide emissions and meteorological information to a computer-based dispersion model to predict dust concentrations in the region and at nearest sensitive receptors for the above scenarios.
4. Compare predicted concentrations with relevant air quality criteria.

The dispersion model chosen for this assessment was CALPUFF which is the most commonly used alternative dispersion model for regulatory dispersion modelling applications in NSW. CALPUFF is a multi-layer, multi-species, non-steady-state Gaussian puff dispersion model that is able to simulate the effects of time- and space-varying meteorological conditions on pollutant transport. This enables the model to account for a variety of effects such as spatial variability of meteorological conditions, causality effects, dry deposition, and dispersion over a variety of spatially varying land surfaces, plume fumigation, low wind speed dispersion, pollutant transformation and wet removal. CALPUFF has been accepted by the USEPA as a guideline model to be used in regulatory applications.

Dispersion modelling was performed for three particle-size categories:

- 0 to 2.5 µm - referred to as PM1 (fine particulate matter);
- 2.5 to 10 µm - referred to as PM2 (coarse matter); and
- 10 to 30 µm - referred to as the PM3 (TSP emission rates calculated using emission factors derived primarily from US EPA (1985) work (see Appendix B)).

CALPUFF source groups are modelled corresponding to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range. The CALPUFF model also has the capability to consider dust emissions that vary in time or with meteorological conditions. This has proved particularly useful for simulating emissions for operations where wind speed is an important factor in determining the rate at which dust is generated. For the current study, the worst-case operational scenario was modelled with the operations represented by a series of volume sources located according to the positions of the dust sources as they would be for the scenario being modelled. The location of the modelled dust sources for the worst-case scenario are presented in Figure 2-7.

Hourly emissions for each source were estimated considering the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the CALPUFF model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at a project site such as this would correspond with periods of low dust generation (because wind erosion and other wind-dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken, then the model has the potential to significantly overstate impacts.

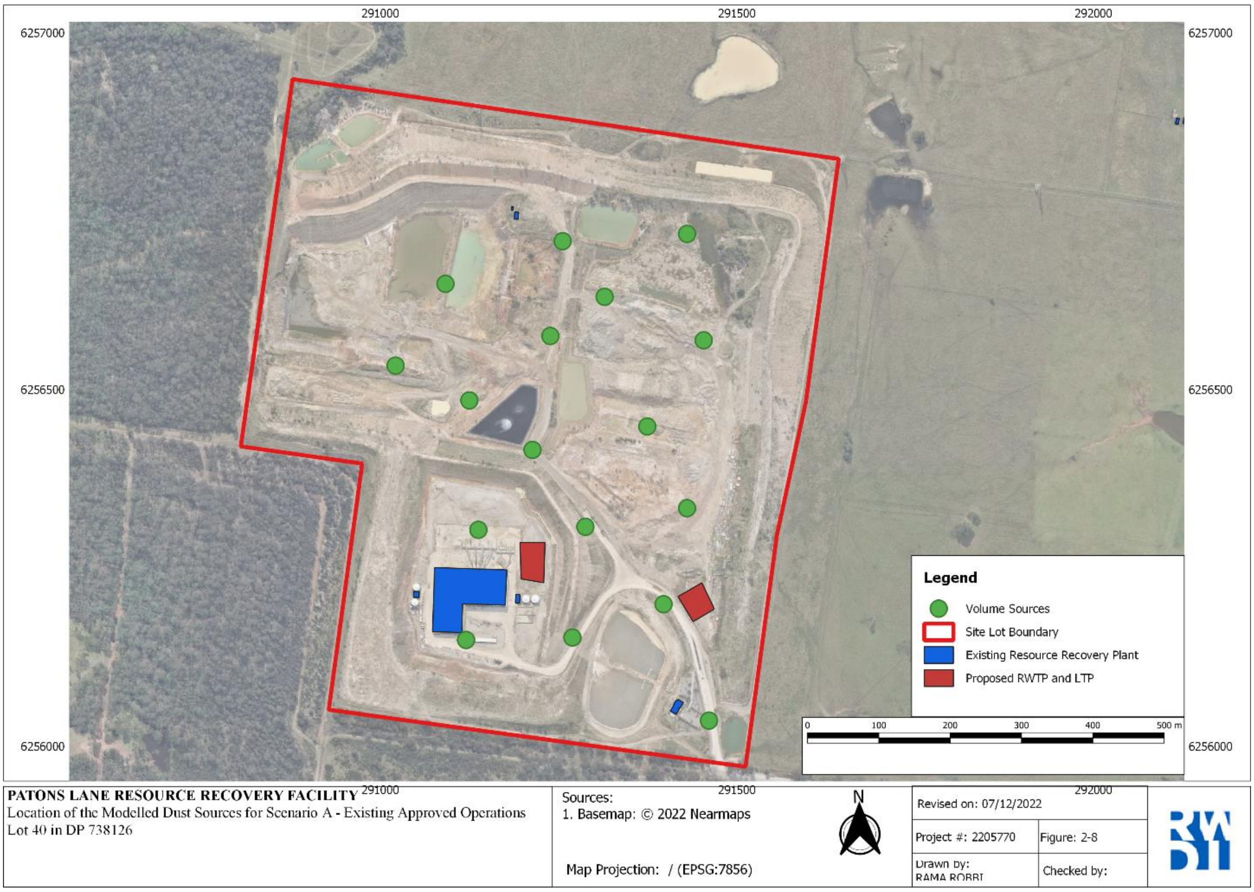


Figure 2-7: Location of the Modelled Dust sources for Scenario A – Approved Worst-case Operations

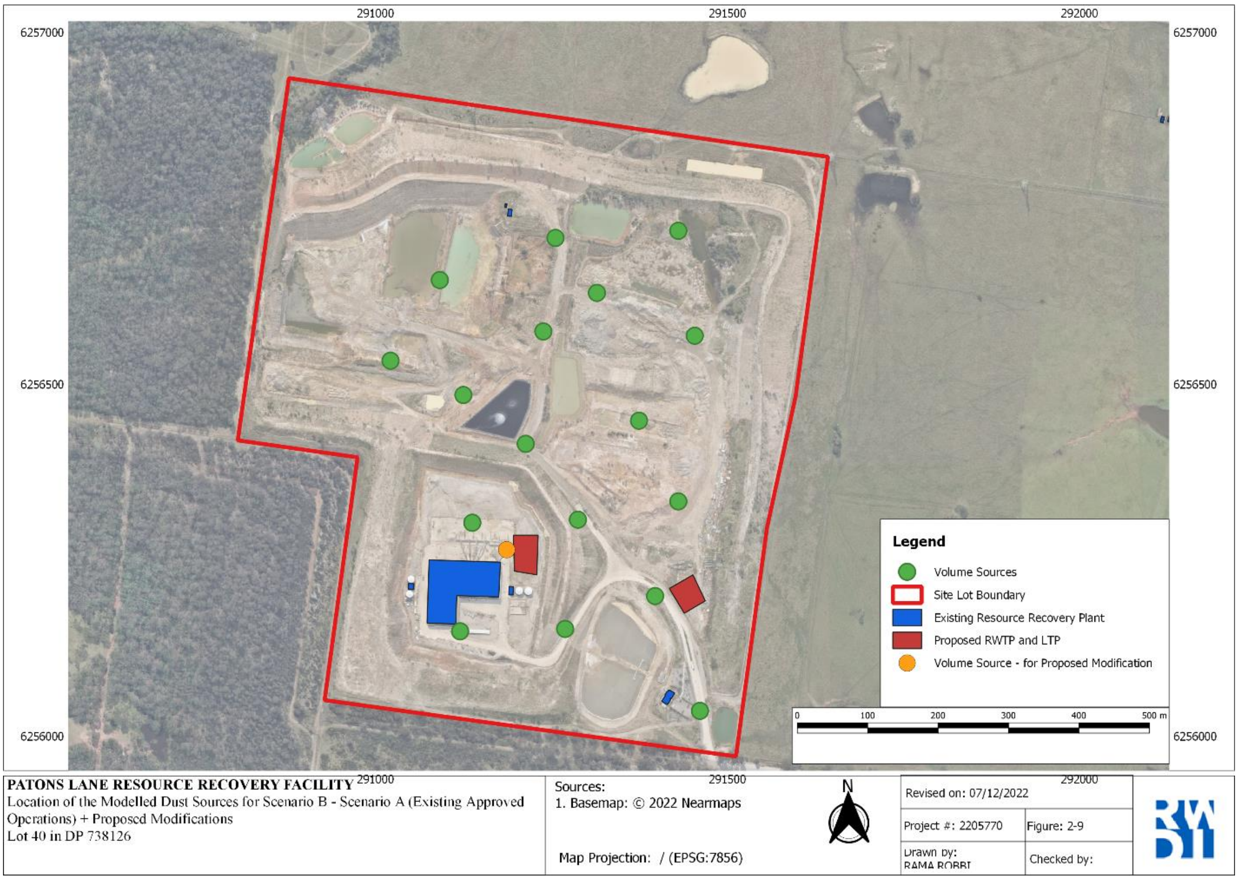


Figure 2-8: Location of the Modelled Dust sources for Scenario B – Approved Worst-case Operations (Scenario A) + Proposed Modifications

Terrain has been considered in the modelling. The modelling has been performed using the meteorological data discussed in Section 2.6 and the dust emission estimates from Appendix B. It has been assumed that each activity will occur between the approved operational hours of 7 am to 5 pm Monday to Friday and Saturday 8 am to 2 pm, except for wind erosion sources which have been modelled for 24 hours per day.

2.8.3 **Operational Odour Assessment**

The approach taken for the operational dust assessment is as follows:

1. Scenario A - Estimate odour emissions of each activity associated with worst case scenario of the previously approved operations as per 2012 approval by PAE Holmes (with operation of landfill activities)
2. Scenario B – This is a combination of Scenario A and the odour emissions from the proposed modifications which are mainly from the RWTP and LTP Operations.
3. Provide emissions and meteorological information to a computer-based dispersion model to predict dust concentrations in the region and at nearest sensitive receptors for the above scenarios.
4. Compare predicted concentrations with relevant air quality criteria.
5. Estimate the odour emissions from the proposed modifications.
6. Provide odour emissions and meteorological information discussed in Section 2.6 to a computer-based dispersion model to predict off-site odour levels from the facility and at nearest sensitive receptors.

7. Compare predicted concentrations with NSW odour assessment criteria.

For the current study, the worst-case operational scenario was modelled with the odour sources represented by area sources. The location of the modelled odour sources for the worst-case scenario are presented in Figure 2-9. The 99th percentile nose-response 1-hour average ground-level odour concentrations have been predicted at nearby sensitive receptors to determine the impact at these locations.

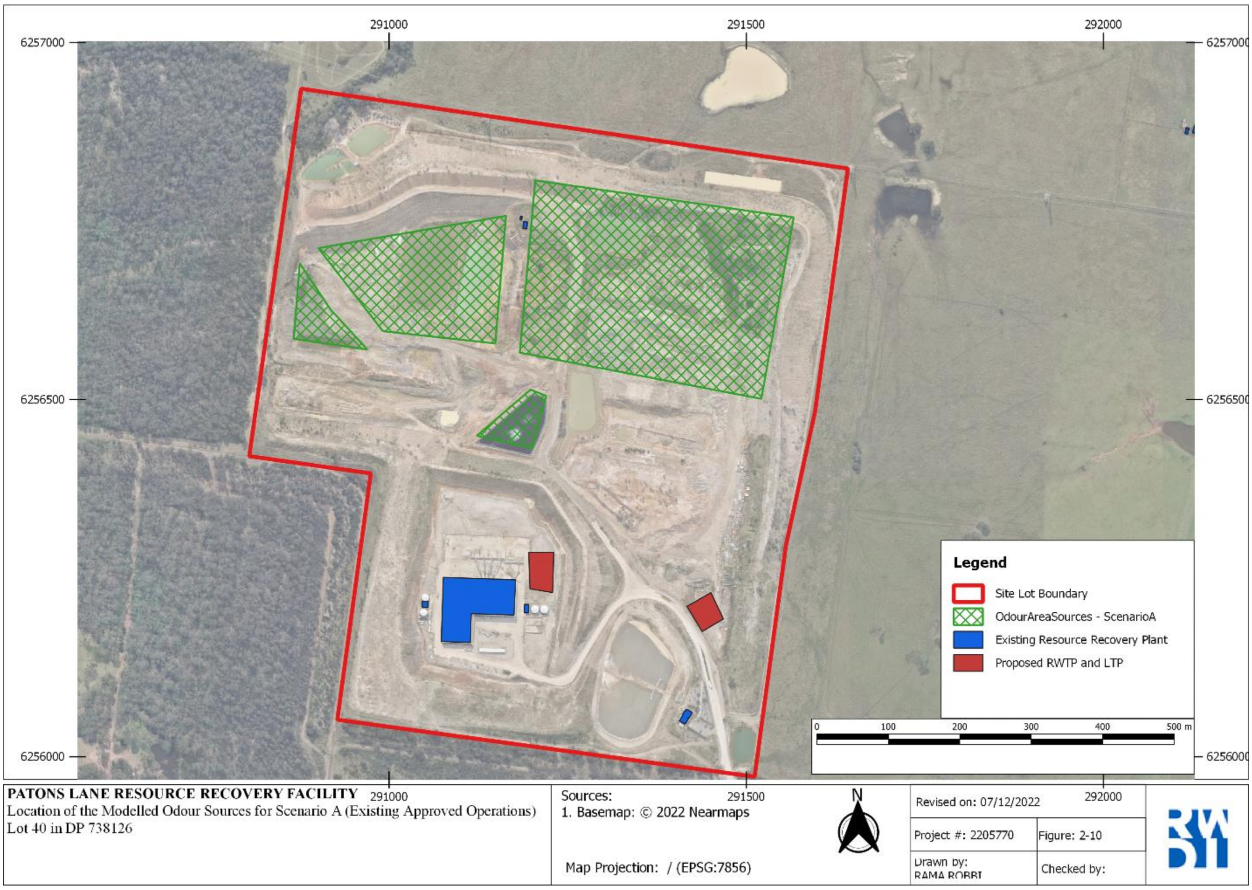


Figure 2-9: Locations of Modelled Odour Sources for Scenario A (Approved Worst-case Operations)

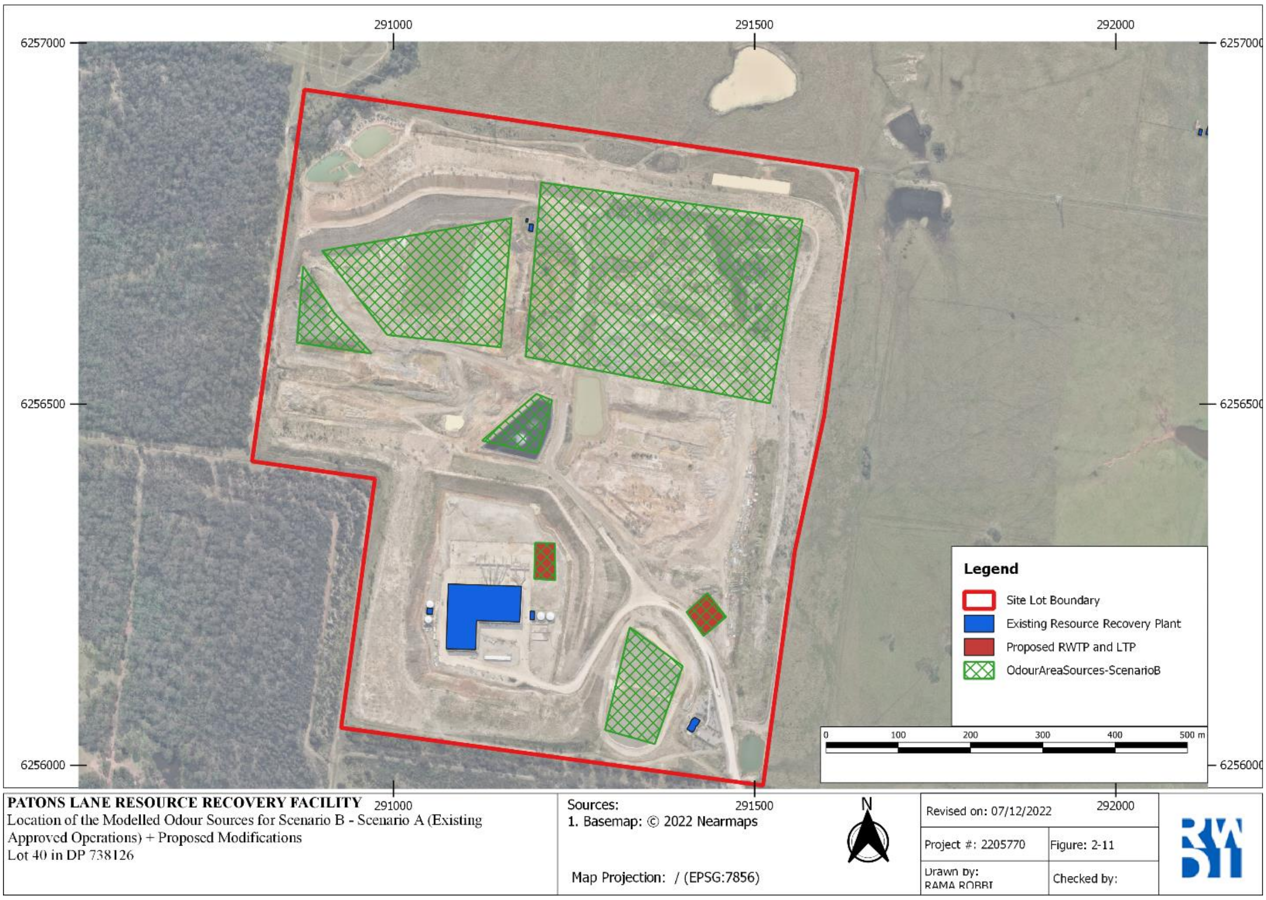


Figure 2-10: Location of the Modelled Odour Sources for Scenario B – Approved Worst-case Operations (Scenario A) + Proposed Modifications

The landfill is categorised as a Class 2 landfill, signifying that no putrescible waste is accepted. Nevertheless, odours can be produced over time from biodegradable material. It has been assumed, for the purposes of this assessment, that odour emissions for historical Class 2 landfills are relevant. These emissions will be referred to as “standard” Class 2 odour emissions.

There are limited odour emissions data available for Class 2 landfills. Measurements made for a non-putrescible landfill site after six months (CEE, 1994) have indicated levels of approximately 0.5 ou.m^3/m^2/min (certainty units). Odours from the site will reach their maximum after a number of years, when it is estimated that emissions may increase by a factor of 14. That is, to model for a worst-case scenario it is necessary to consider the potential increase in odour over time to approximately 7 ou.m^3/m^2/min (or 0.117 ou.m^3/m^2/s). These worst-case emissions, however, will not occur over the whole area. As the landfill progresses, emissions from the previously capped cells will rise to a peak and then fall again.

An average emission rate was then taken to apply for the landfill area. As the proportion of biodegradable material accepted to landfill for this project will be low (and substantially lower than that accepted by Class 2 landfills in the 1990s), a proportionate reduction to the standard Class 2 odour emissions is considered to be appropriate. As a conservative approach, odour emissions from capped areas have therefore been taken to be 5% of the standard historical Class 2 odour emissions. In addition to odours from capped areas, there may be small quantities of odour emitted from the active tipping face and the existing leachate evaporation pond and existing stormwater leachate dam.

Appendix B provides the quantitative information on each odour source used in the dispersion modelling. Odour emissions in the dispersion model have been multiplied by the recommended peak-to-mean ratios for different source types to predict odour levels for nose response times. Peak-to-mean factors for the near-field have been applied for the purposes of this assessment. For area sources, these factors have numerical values of 2.5 for unstable and neutral atmospheric conditions and 2.3 for stable conditions in the near field.

3 RESULTS AND DISCUSSIONS

3.1 Assessment of Construction Dust Impacts

The following qualitative risk assessment of potential dust impacts has been conducted for the proposed construction works.

3.1.1 Step 1 – Screen the Need for a Detailed Assessment

The IAQM guidance recommends that a risk assessment of potential dust impacts from construction activities be undertaken when human receptors are located within:

- 350m of the boundary of the site; or,
- 50m of the route(s) used by construction vehicles on public roads up to 500m from the site entrance(s).

As all the nearby sensitive receptors identified in Table 2-1 and shown in Figure 2-1 are more than 500m away, so a detailed assessment is not needed for the proposed modification.

3.1.2 Step 2A – Potential Dust Emission Magnitude

In accordance with the IAQM guidance (Section 7, Step 2: Assess the Risk of Dust Impacts), the dust emission magnitude for the proposed modification:

- Low/negligible for demolition.
- Low for earthworks.
- Small for Construction
- Small for Trackout

3.1.3 Step 2B – Sensitivity of Surrounding Area

The sensitivity of the surrounding area to dust impacts considers a number of factors, including:

- Specific receptor sensitivities;
- The number of receptors and their proximity to the works;
- Existing background dust concentrations; and,
- Site-specific factors that may reduce impacts, such as trees that may reduce wind-blown dust.

In accordance with the IAQM guideline, the following receptor sensitivity has been determined:

- **Low** sensitivity to dust soiling.
- **Low** sensitivity to human health.

3.1.4 Step 2C – Define the Risk of Impacts

To define the risk of impacts, the dust emission magnitude (“small” for this site) is combined with the sensitivity of the area, for demolition, earthworks, construction and trackout, respectively.

Therefore, in accordance with the IAQM guideline, the following risks has been determined:

- Demolition works - **Low** risk for both dust soiling and human health
- Earthwork Activities - **Low** risk for both dust soiling and human health
- Construction Activities - **Low** risk for both dust soiling and human health
- Haulage/Trackout activities - **Low** risk for both dust soiling and human health

It is important to note that the above risks assume that the dust mitigation measures are not implemented.

3.1.5 Step 3 – Site-Specific Mitigation

The IAQM guidance document identifies a range of appropriate dust mitigation measures that should be implemented as a function of the risk of impacts. These measures are presented in Section 4.2.

3.1.6 Step 4 – Significance of Residual Impacts

In accordance with the IAQM guidance document, the final step in the assessment is to determine the significance of any residual impacts, following the implementation of mitigation measures. To this end, the guidance states:

> *"For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be "not significant".*

Based on the proposed works, and the advice in the IAQM guidance document, it is considered unlikely that these works would result in unacceptable air quality impacts, subject to the implementation of the mitigation measures outlined in Section 6.

3.2 Assessment of Operational Dust Impacts

This section presents the dispersion modelling results and discusses the likely off-site air quality impacts associated with the scenarios discussed in the section 2.8.2.

3.2.1 Operational Dust Impacts from Scenario A (Approved worst-case Operations)

To assess predicted concentrations over a 24-hour period, it is more complicated than simply adding a constant average 24-hour background concentration to the model results. PM_{10} averages vary considerably from day-to-day as they are subject to the local meteorological conditions at the time. Adding the maximum measured 24-hour average PM_{10} concentration to the predicted maximum 24-hour average concentration over a year would represent a very conservative approach as it is unlikely that the worst-case emissions from the Project would occur at the same time as the highest background concentrations.

It should be noted that vegetation reduces TSP and PM10 emissions by up to 30% (Warren, 1973). However, the air quality modelling has not considered the screening impact of the vegetation that exists between the proposed operations and the sensitive receptors, and as such the predicted concentrations of TSP and PM_{10} represent a conservative approach.

Table 3-1 presents the maximum predicted 24-Hour average ground level concentrations of $PM_{2.5}$ and PM_{10} for approved worst-case operations (scenario 3b of 2012 approval by PAE Holmes) and the existing background concentrations (local ambient air quality data).

The results in Table 3-1 show that the approved worst-case operations are not predicted to result in any additional exceedances of the impact assessment criteria for $PM_{2.5}$ and PM_{10} concentrations compared to background levels. Table 3-2 presents the annual average concentrations of $PM_{2.5}$ and PM_{10} for approved worst-case operations and the existing background concentrations.

The results in Table 3-2 show that the approved worst-case operations would have a small effect on annual average $PM_{2.5}$ and PM_{10} concentrations, which comply with the impact assessment criteria. Although background concentration is very high, the contribution from the approved worst-case operations to annual average $PM_{2.5}$ and PM_{10} is approximately 3% and 7% respectively, of the impact assessment criteria (at receptor W).

Table 3-3 presents the predicted annual average TSP concentrations and deposited dust levels due to the approved worst-case operations and the existing background concentrations.

The results in Table 3-3 show that the predicted TSP concentrations and deposited dust levels comply with the impact assessment criteria. Contour plots of incremental 24-hour average $PM_{2.5}$ and PM_{10} from the approved worst-case operations are presented in Appendix C.

Table 3-1: Predicted 24-hour Average $PM_{2.5}$ and PM_{10} Concentrations at Sensitive Receptors – Scenario A – Approved Worst-case Operations

Receptor	Maximum 24-hour Average $PM_{2.5}$ (µg/m^3)			Maximum 24-hour Average PM_{10} (µg/m^3)		
	Highest Predicted Increment from approved worst-case Operations	Background (local ambient air quality)	Increment + Background	Highest Predicted Increment from Approved worst-case Operations	Background (local ambient air quality)	Increment + Background
A	3.54	2.00	5.54	22.85	10.00	32.85
B	2.61	4.40	7.01	16.97	19.30	36.27
C	1.91	3.20	5.11	12.36	21.50	33.86
D	2.45	3.20	5.65	15.87	21.50	37.37
E	2.01	3.20	5.21	12.98	21.50	34.48
F	2.15	3.20	5.35	13.92	21.50	35.42
G	1.84	3.20	5.04	11.85	21.50	33.35
H	1.61	3.20	4.81	10.35	21.50	31.85
I	1.64	3.20	4.84	10.59	21.50	32.09
J	1.63	3.20	4.83	10.51	21.50	32.01
K	1.56	3.20	4.76	10.03	21.50	31.53
L	1.54	3.20	4.74	9.96	21.50	31.46
M	1.46	3.20	4.66	9.40	21.50	30.90
N	1.46	3.20	4.66	9.39	21.50	30.89
O	1.40	3.20	4.60	9.07	21.50	30.57
P	1.35	3.20	4.55	8.59	19.34	27.93
Q	1.35	3.20	4.55	8.65	19.34	27.99
R	1.34	3.20	4.54	8.57	19.34	27.92
S	1.38	3.20	4.58	8.83	19.34	28.17
T	1.35	3.20	4.55	8.69	19.34	28.04
U	0.99	3.90	4.89	6.21	19.33	25.55
V	1.28	3.90	5.18	8.20	19.33	27.53
W	2.09	3.60	5.69	13.72	8.80	22.52
X	1.97	4.60	6.57	12.95	19.34	32.29
Criteria	-	-	**25**	-	-	**50**

Table 3-2: Predicted Annual Average $PM_{2.5}$ and PM_{10} Concentrations at Sensitive Receptors – Scenario A – Approved Worst-case Operations

Receptor	Annual Average $PM_{2.5}$ (µg/m^3)		Annual Average PM_{10} (µg/m^3)	
	Increment (Approved worst-case Operations)	Increment + Background	Increment (Approved worst-case Operations)	Increment + Background
A	0.24	7.94	1.54	20.90
B	0.20	7.90	1.32	20.68
C	0.06	7.76	0.38	19.74
D	0.06	7.76	0.38	19.74
E	0.05	7.75	0.31	19.67
F	0.05	7.75	0.31	19.67
G	0.04	7.74	0.28	19.64
H	0.03	7.73	0.22	19.58
I	0.04	7.74	0.24	19.60
J	0.04	7.74	0.25	19.61
K	0.04	7.74	0.25	19.61
L	0.04	7.74	0.26	19.62
M	0.04	7.74	0.27	19.63
N	0.05	7.75	0.29	19.65
O	0.05	7.75	0.30	19.66
P	0.05	7.75	0.31	19.67
Q	0.05	7.75	0.32	19.68
R	0.05	7.75	0.33	19.69
S	0.05	7.75	0.34	19.70
T	0.06	7.76	0.36	19.72
U	0.09	7.79	0.56	19.92
V	0.18	7.88	1.16	20.52
W	0.27	7.97	1.76	21.12
X	0.24	7.94	1.53	20.89
Criteria	**-**	**8**	**-**	**25**

Table 3-3: Predicted Annual Average TSP Concentrations and Deposited Dust Levels at Sensitive Receptors – Scenario A – Approved Worst-Case Operations

Receptor	Annual Average TSP (µg/m³)		Annual Average Deposited Dust (g/m²/month)	
	Increment (Approved worst-case Operations)	Increment + Background	Increment (Approved worst-case Operations)	Increment + Background
A	2.63	51.03	0.058	2.208
B	2.29	50.69	0.057	2.207
C	0.63	49.03	0.019	2.169
D	0.63	49.03	0.017	2.167
E	0.50	48.90	0.015	2.165
F	0.51	48.91	0.014	2.164
G	0.45	48.85	0.012	2.162
H	0.35	48.75	0.010	2.160
I	0.39	48.79	0.012	2.162
J	0.40	48.80	0.012	2.162
K	0.41	48.81	0.013	2.163
L	0.43	48.83	0.013	2.163
M	0.45	48.85	0.014	2.164
N	0.47	48.87	0.015	2.165
O	0.49	48.89	0.015	2.165
P	0.51	48.91	0.016	2.166
Q	0.53	48.93	0.017	2.167
R	0.54	48.94	0.018	2.168
S	0.57	48.97	0.018	2.168
T	0.60	49.00	0.019	2.169
U	0.95	49.35	0.066	2.216
V	2.13	50.53	0.124	2.274
W	3.25	51.65	0.145	2.295
X	2.73	51.13	0.108	2.258
Criteria	**-**	**90**	**2**	**4**

3.2.2 Operational Dust Impacts from Scenario B (Approved Worst-Case Operations + Proposed Modifications)

Table 3-4 presents the maximum predicted 24-Hour average ground level concentrations of $PM_{2.5}$ and PM_{10} for the approved worst-case operations (Scenario A) plus proposed modifications and the existing background concentrations (local ambient air quality data).

The results in Table 3-4 show that the approved worst-case operation with proposed modifications is not predicted to result in any additional exceedances of the impact assessment criteria for $PM_{2.5}$ and PM_{10} concentrations compared to background levels.

Table 3-5 presents the annual average concentrations of $PM_{2.5}$ and PM_{10} for the approved worst-case operations (Scenario A) plus proposed modifications and the existing background concentrations.

The results in Table 3-5 show that the approved worst-case operation with proposed modifications would have a small effect on annual average $PM_{2.5}$ and PM_{10} concentrations, which comply with the impact assessment criteria. Although background concentration is very high, the contribution from the approved worst-case operations plus proposed modifications to annual average $PM_{2.5}$ and PM_{10} is approximately 4% and 7.2% respectively, of the impact assessment criteria (at receptor W).

Table 3-6 presents the predicted annual average TSP concentrations and deposited dust levels due to the existing approved worst-case operations plus proposed modifications and the existing background concentrations.

The results in Table 3-6 show that the predicted TSP concentrations and deposited dust levels comply with the impact assessment criteria. Contour plots of incremental 24-hour average $PM_{2.5}$ and PM_{10} from Scenario B (existing approved worst-case operations plus proposed modifications) are presented in Appendix C.

The overall incremental dust impact from the proposed modifications is minimal and the proposed modifications will not cause any adverse dust impacts at the nearest sensitive receptors.

Table 3-4: Predicted 24-hour Average $PM_{2.5}$ and PM_{10} Concentrations at Sensitive Receptors – Scenario B – Approved Worst-case Operations + Proposed Modifications

Receptor	Maximum 24-hour Average $PM_{2.5}$ ($\mu g/m^3$)			Maximum 24-hour Average PM_{10} ($\mu g/m^3$)		
	Highest Predicted Increment from Approved worst-case Operations + Proposed Modifications	Background (local ambient air quality)	Increment + Background	Highest Predicted Increment from Approved worst-case Operations + Proposed Modifications	Background (local ambient air quality)	Increment + Background
A	3.55	2.00	5.55	22.93	10.00	32.93
B	2.63	4.40	7.03	17.09	19.30	36.39
C	1.92	3.20	5.12	12.42	21.50	33.92

Receptor	Maximum 24-hour Average $PM_{2.5}$ (µg/m³)			Maximum 24-hour Average PM_{10} (µg/m³)		
	Highest Predicted Increment from Approved worst-case Operations + Proposed Modifications	Background (local ambient air quality)	Increment + Background	Highest Predicted Increment from Approved worst-case Operations + Proposed Modifications	Background (local ambient air quality)	Increment + Background
D	2.49	3.20	5.69	16.09	21.50	37.59
E	2.02	3.20	5.22	13.02	21.50	34.52
F	2.20	3.20	5.40	14.19	21.50	35.69
G	1.92	3.20	5.12	12.37	21.50	33.87
H	1.65	3.20	4.85	10.61	21.50	32.11
I	1.65	3.20	4.85	10.64	21.50	32.14
J	1.64	3.20	4.84	10.52	21.50	32.02
K	1.57	3.20	4.77	10.04	21.50	31.54
L	1.55	3.20	4.75	9.97	21.50	31.47
M	1.47	3.20	4.67	9.42	21.50	30.92
N	1.47	3.20	4.67	9.41	21.50	30.91
O	1.41	3.20	4.61	9.08	21.50	30.58
P	1.39	3.20	4.59	8.87	19.34	28.21
Q	1.39	3.20	4.59	8.88	19.34	28.22
R	1.37	3.20	4.57	8.76	19.34	28.10
S	1.40	3.20	4.60	8.99	19.34	28.33
T	1.37	3.20	4.57	8.82	19.34	28.16
U	1.08	3.90	4.98	6.74	19.33	26.07
V	1.39	3.90	5.29	8.86	19.33	28.20
W	2.10	3.60	5.70	13.73	8.80	22.53
X	2.06	4.60	6.66	13.41	19.34	32.75
Criteria	-	-	**25**	-	-	**50**

Table 3-5: Predicted Annual Average $PM_{2.5}$ and PM_{10} Concentrations at Sensitive Receptors – Scenario B – Approved Worst-case Operations + Proposed Modifications

Receptor	Annual Average $PM_{2.5}$ (µg/m³)		Annual Average PM_{10} (µg/m³)	
	Increment (Existing Approved worst-case Operations + Proposed Modifications)	Increment + Background	Increment (Existing Approved worst-case Operations + Proposed Modifications)	Increment + Background
A	0.24	7.945	1.57	20.93
B	0.21	7.910	1.35	20.71
C	0.06	7.762	0.39	19.75
D	0.06	7.762	0.40	19.76
E	0.05	7.750	0.32	19.68
F	0.05	7.751	0.32	19.68
G	0.05	7.745	0.29	19.65
H	0.04	7.736	0.23	19.59
I	0.04	7.739	0.25	19.61
J	0.04	7.740	0.25	19.61
K	0.04	7.741	0.26	19.62
L	0.04	7.743	0.27	19.63
M	0.04	7.744	0.28	19.64
N	0.05	7.747	0.30	19.66
O	0.05	7.749	0.31	19.67
P	0.05	7.750	0.32	19.68
Q	0.05	7.751	0.33	19.69
R	0.05	7.753	0.34	19.70
S	0.06	7.755	0.35	19.71
T	0.06	7.758	0.37	19.73
U	0.09	7.789	0.57	19.93
V	0.18	7.883	1.19	20.55
W	0.28	7.976	1.79	21.15
X	0.24	7.940	1.55	20.91
Criteria	**-**	**8**	**-**	**25**

Table 3-6: Predicted Annual Average TSP Concentrations and Deposited Dust Levels at Sensitive Receptors – Scenario B – Approved Worst-case Operations + Proposed Modifications

Receptor	Annual Average TSP (µg/m^3)		Annual Average Deposited Dust (g/m^2/month)	
	Increment (Approved worst-case Operations + Proposed Modifications)	Increment + Background	Increment (Approved worst-case Operations + Proposed Modifications)	Increment + Background
A	2.70	51.10	0.059	2.209
B	2.35	50.75	0.059	2.209
C	0.65	49.05	0.019	2.169
D	0.65	49.05	0.018	2.168
E	0.52	48.92	0.015	2.165
F	0.53	48.93	0.015	2.165
G	0.46	48.86	0.013	2.163
H	0.37	48.77	0.010	2.160
I	0.40	48.80	0.012	2.162
J	0.42	48.82	0.013	2.163
K	0.43	48.83	0.013	2.163
L	0.45	48.85	0.014	2.164
M	0.46	48.86	0.015	2.165
N	0.49	48.89	0.015	2.165
O	0.51	48.91	0.016	2.166
P	0.53	48.93	0.017	2.167
Q	0.54	48.94	0.017	2.167
R	0.56	48.96	0.018	2.168
S	0.59	48.99	0.019	2.169
T	0.62	49.02	0.020	2.170
U	0.98	49.38	0.068	2.218
V	2.18	50.58	0.127	2.277
W	3.32	51.72	0.148	2.298
X	2.79	51.19	0.111	2.261
Criteria	**-**	**90**	**2**	**4**

3.3 Assessment of Odour Impacts

3.3.1 Operational Odour Impacts from Scenario A (Approved Worst-Case Operations)

Table 3-7 presents the maximum predicted ground level concentrations of Odour due to Scenario A (approved worst-case operations). Contour plots of incremental 1-hour Average 99th Percentile ground level odour Concentrations are presented in Appendix D.

Table 3-7: Predicted 1-hour Average 99th Percentile ground level odour Concentrations at Sensitive Receptors – Scenario A – Approved Worst Case Operations

Receptor	Highest Predicted 1-hour Average 99th Percentile ground level odour Concentrations
A	0.222
B	0.158
C	0.060
D	0.061
E	0.050
F	0.051
G	0.045
H	0.033
I	0.038
J	0.039
K	0.041
L	0.042
M	0.043
N	0.047
O	0.049
P	0.048
Q	0.048
R	0.049
S	0.052
T	0.052
U	0.128
V	0.212
W	0.219

Receptor	Highest Predicted 1-hour Average 99th Percentile ground level odour Concentrations
X	0.193
Criteria	**7.0**

The results in Table 3-7 show that the odour from Scenario A (approved worst-case operations) is not predicted to result in any additional exceedances of the impact assessment criteria for Odour concentration.

3.3.2 Operational Odour Impacts from Scenario B (Approved Worst-case Operations + Proposed Modifications)

Table 3-8 presents the maximum predicted ground level concentrations of Odour due to Scenario B (approved worst-case operations + Proposed Modifications). Contour plots of incremental 1-hour Average 99th Percentile ground level odour Concentrations are presented in Appendix D.

Table 3-8: Predicted 1-hour Average 99th Percentile ground level odour Concentrations at Sensitive Receptors - Scenario B (Approved Worst-case Operations + Proposed Modifications)

Receptor	Highest Predicted 1-hour Average 99th Percentile ground level odour Concentrations
A	0.246
B	0.189
C	0.077
D	0.082
E	0.068
F	0.072
G	0.063
H	0.047
I	0.052
J	0.053
K	0.055
L	0.056
M	0.054
N	0.058
O	0.061
P	0.061
Q	0.062
R	0.063
S	0.066

Receptor	Highest Predicted 1-hour Average 99th Percentile ground level odour Concentrations
T	0.069
U	0.150
V	0.249
W	0.253
X	0.224
Criteria	**7.0**

The results in Table 3-8 show that the odour from Scenario B (approved worst-case operations + proposed modifications) is not predicted to result in any additional exceedances of the impact assessment criteria for Odour concentration.

Potential Odour impacts associated with the proposed modifications are not likely to be significant and will not compromise public health or amenity.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

RWDI has been engaged by Jackson Environment and Planning Pty Ltd., to conduct an air quality impact assessment (AQIA) for the proposed modifications for PLRCC located at 123-179 Patons Lane, Orchard Hills, NSW.

A risk-based approach in accordance with the IAQM (2014) guidance was adopted to assess dust emissions from the construction of the proposed modifications. The assessment concluded that there would be a low risk of dust impacts from construction and no significant air quality impacts are expected to occur during the construction of the proposed modifications.

Quantitative assessments of potential dust and odour impacts from the operation of the proposed modification have been conducted, based on CALMET meteorological simulations and the CALPUFF dispersion modelling system.

The results of the dispersion modelling indicated that dust and odour impact from operation and construction of the proposed modifications will comply with established criteria at all sensitive receptors. It is expected that dust and odour generated from the operation and construction of the proposed modifications will meet relevant standards.

Some dust mitigation measures have been identified in Section 4.2 to further reduce air quality impacts associated with the construction and operation of the proposed modification.

4.2 Dust Mitigation and Management

4.2.1 Construction

The assessment of potential dust impacts during construction works indicate that the proposed modifications will have a low risk of both dust soiling and human health impacts from earthworks and construction activities.

Activities during construction are consistent with PLRRC's operations and therefore the existing dust controls implemented for site operations are equally relevant to the construction phase. Similarly, the existing Environmental Management Strategy (EMS) and the Air Quality and Greenhouse Gas Management Plan (AQ&GHGMP) for the PLRRC should be followed for the construction of the proposed modification, so that air quality impacts are minimized.

4.2.2 Operation

Air quality impacts associated with the operation of the proposed modifications are predicted to comply with relevant impact assessment criteria.

The existing dust controls along with existing EMS and AQ&GHGMP should be followed for the operation of the proposed modification, so that air quality impacts are minimized.

5 STATEMENT OF LIMITATIONS

This report entitled *Patons Lane Resource Recovery Facility – Integrated Water and Leachate Plant Modifications*, dated December 16, 2022, was prepared by RWDI Australia Pty Ltd ("RWDI") for by Jackson Environment and Planning Pty Ltd. ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

6 REFERENCES

NSW EPA, 2006: Technical Notes - Assessment and management of odour from stationary sources in NSW. Accessible at: https://www.environment.nsw.gov.au/resources/air/20060441notes.pdf

NSW EPA, 2022: Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2022). Applicable as of 9 September 2022. Accessible at: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/22p3963-approved-methods-for-modelling-and-assessment-of-air-pollutants.pdf?la=en&hash=79991C3AD2F7A1FAEC34EBAA857E7D0CCDDD1B24

IAQM (Institute of Air Quality Management in the United Kingdom), 2014: Guidance on the Assessment of Dust from Demolition and Construction. Accessible at: http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Consulting Environmental Engineers (1994): Report on predictive odour modelling. Report prepared by T. Belair for Pacific Waste in Land and Environment Court proceedings.

PAE Holmes, 2012: Supplementary Air Quality Assessment, Modified Preferred Project, Orchard Hills Waste and Resource Management Facility. Report prepared by Dellara Pty, Ltd.

APPENDIX A

METEOROLOGICAL INFORMATION

A.1 INTRODUCTION

This Appendix provides details on CALMET (Section A.2) inputs that are not provided in the main text of the Patons Lane Resource Recovery Facility – Integrated Water and Leachate Plant Modifications, Air Quality Impact Assessment Report. Some CALMET output is shown and briefly discussed in Section A.3 to demonstrate that CALMET produces meteorological input to CALPUFF that is consistent with observed and expected meteorological conditions. Terrain and land use in the study area are shown in Figures A.1 and A.2, respectively. CALMET was ran with a 200m grid resolution to resolve the spatial variability in land use and terrain within the domain.

A.2 THE AIR POLLUTION MODEL (TAPM)

The Air Pollution Model (TAPM) a CSIRO developed meteorological and air dispersion model was used to accurately account for terrain and land use effects in this region to facilitate the development of the preprocessing spatially varying hourly meteorological data that feed into the numerical air dispersion model.

TAPM produces meteorological data, upper air information and temperature profiles for the simulation period in three dimensions for all the grid points across the domain. The gridded meteorological data generated by TAPM is calculated from the synoptic information determined from the six-hour interval limited area prediction system (LAPS). The predicted meteorological dataset is representative of the local topography, land use, surface roughness and temperature effects caused by water bodies.

The TAPM nesting grid or mesh was determined for this model via the consideration of the required terrain resolution in the radius of influence (~ 35 km). Given the absence of any significant terrain features within the radius of influence a coarser mesh with a minimum density of 1,000 m was deemed to represent the topography of the area accurately.

There is some conjecture regarding TAPM's ability to predict ground level wind conditions during stable meteorological conditions. Various validation studies that demonstrate TAPM's ability to predict meteorological conditions and hence pollutant dispersion accurately have been conducted.

To accurately predict the localized meteorological conditions at the site of the proposed facility, TAPM meteorological data was assimilated with contemporaneous, observed conditions using a full year of hourly Bureau of Meteorology wind speed and direction observation from Penrith Lakes and St. Mary's stations for the reference year (2018). The data predicted from the TAPM simulation was then input used as initial inputs into the CALMET diagnostic meteorological model to yield a gridded meteorological dataset for use by the CALPUFF dispersion model.

A basic summary of the data and parameters used in the TAPM meteorogical model is given in Table A-1.

Table A.1: TAPM meteorological simulation: model setup parameters

Parameter	Meteorology
Grid Center Coordinates	33°48'40"S 150°44'41"E Easting 291250m Northing 6256500m
Reference Year	2018 GMT + 10
Grid (nx, ny, nz)	(41, 41, 25)
Assimilation dataset source	Bureau of Meteorology

A.3 CALMET

This section presents the input parameters selected to run CALMET (Table A.2).

Figure A.1: Terrain Elevation in CALMET Domain (height above average sea level (m))

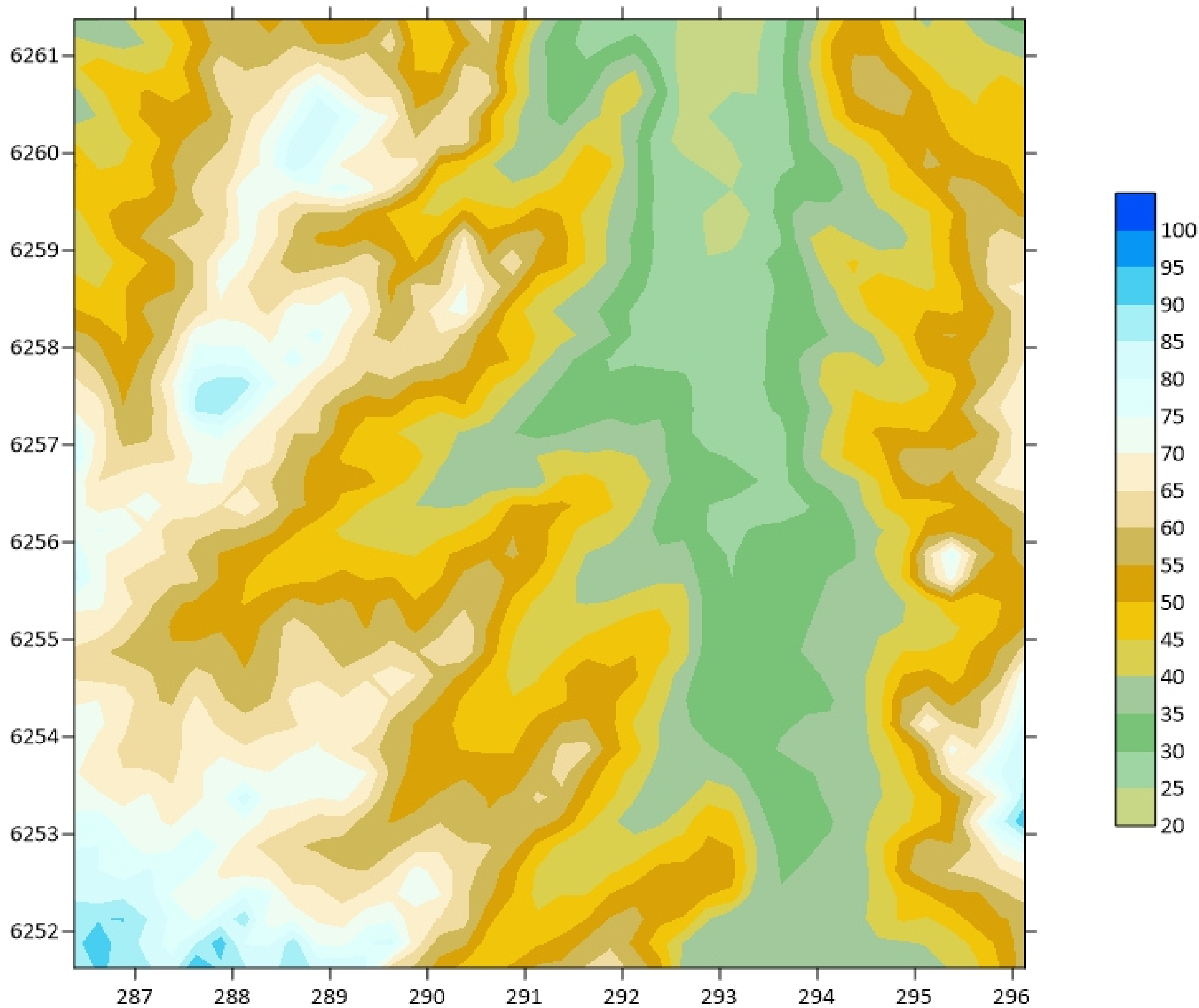
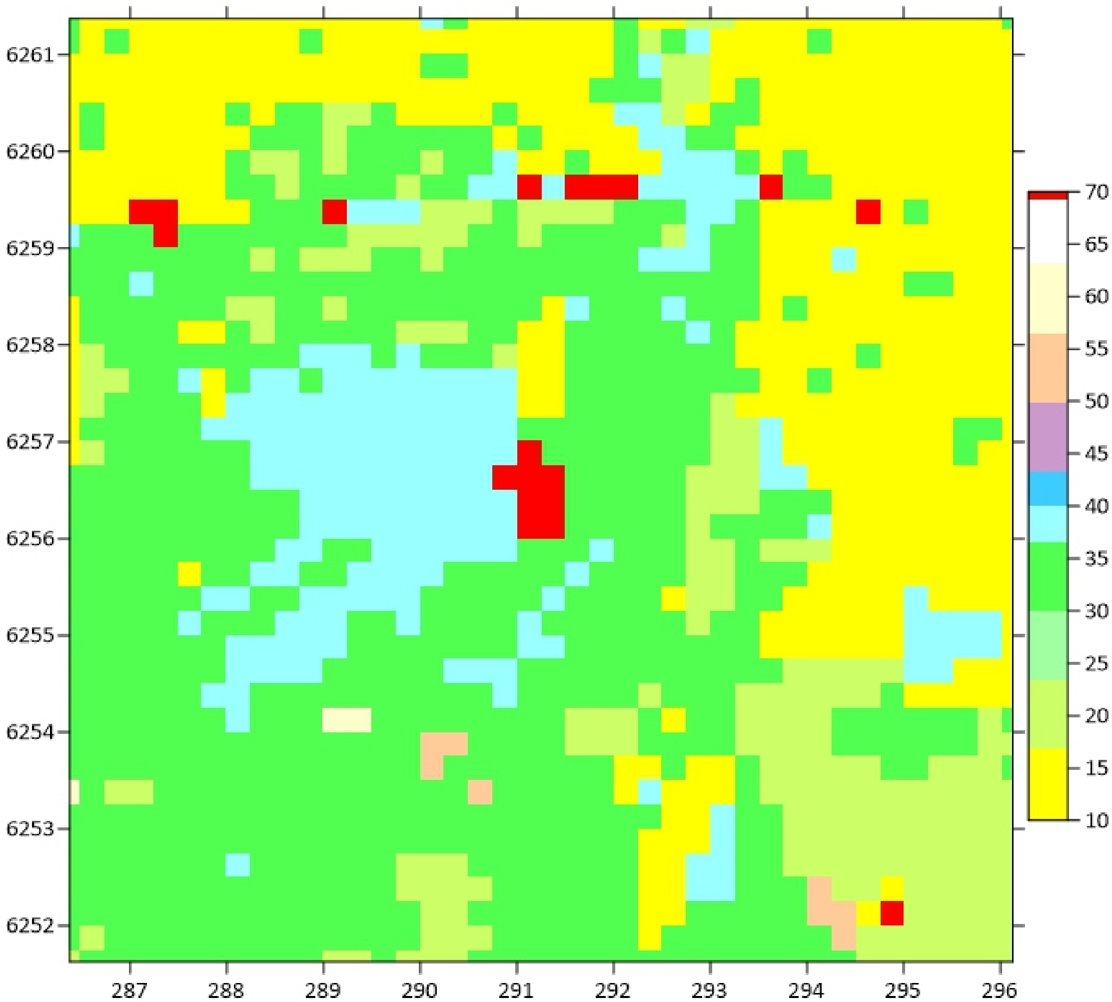


Figure A.2: Land Use in CALMET Domain



CALMET landuse categories:

10 : Urban or Built-up Land;
15 to 25: Agricultural Land – unirrigated
25 to 35: Rangeland
35 to 45: Forest Land
51 to 55: Water
58 to 62: Wetland
63 to 70: Barren Land

Table A.2: CALMET model switch settings group 5 - Wind Field Options and Parameters

Parameter	Default	Project	Comments
IWFCOD	1	1	Diagnostic wind module used
IFRADJ	1	1	Froude number adjustment effects computed
IKINE	0	0	Kinematic effects not computed
IOBR	0	0	No adjustment to vertical velocity profile at top of model domain
ISLOPE	1	1	Slope flow effects computed
IEXTRP	-4	-4	Similarity theory to extrapolate surface observed winds (not upper air observations hence <0)
ICALM	0	0	Surface winds not extrapolated if calm
BIAS	NZ*0	NZ*0	irrelevant since no upper air station data
RMIN2	4	-1	Used to ensure extrapolation of all surface stations for IEXTRP = -4
IPROG	0	14	Used TAPM prognostic model output for initial guess field (IGF)
ISTEPPGS	3600	3600	Hourly WRF fields
LVARY	F	T	Varying radius of influence
RMAX1	NA	5	Complex terrain limits representativeness of surface observations away from station locations
RMAX2	NA	5	For extrapolated sfc obs (no upper air stations)
RMAX3	NA	5	Irrelevant (no overwater stations)
RMIN	0.1	0.1	
TERRAD	NA	3	Identified from main terrain feature of influence smaller than TAPM resolution (which captures terrain effects at coarser scale)
R1	NA	2	Favors IGF+terrain effects over observed winds away from met station locations (complex terrain)
R2	NA	5	Favors IGF+terrain effects over vertically extrapolated observed winds away from met station locations (complex terrain)
NBAR	0	0	Barriers not used
ISURFT	-1	-1	Diagnostic module surface temperatures based on 2-D spatially varying temperature field
IDIOPT2	0	0	Lapse rate computed internally
IUPT	-1	-1	Upper air stations not used
ZUPT	200	200	Lapse rate computed for default depth

A.3.1. Results

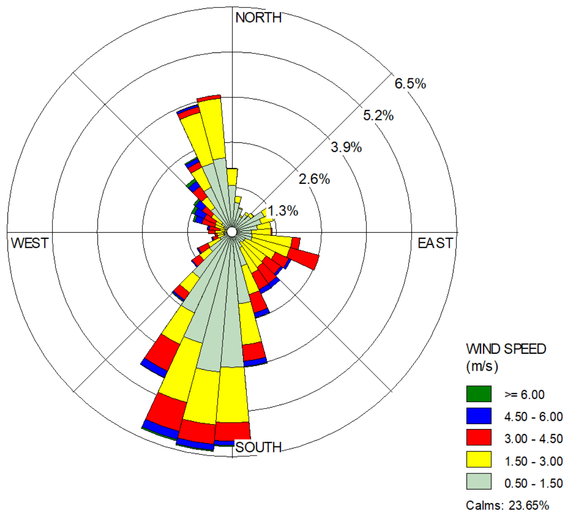
The CALMET model performance was assessed by reviewing various model outputs and, where possible, comparing to observations. These outputs include surface wind roses for various monitoring locations, CALMET-derived stabilities and mixing heights and domain wind vector plots under various stability and flow regimes.

A.3.2. Surface Winds

Annual windroses display the combined frequency distribution of wind speed and direction at a given location over the course of a year. CALMET is designed to match the observations that have been assimilated in the modelling at the observation sites. Windroses based on modelled winds should therefore closely match windroses based on observations, if the modelled windroses are extracted at a model grid point nearly co-located to meteorological stations. In complex terrain situations, even a small location departure may cause additional terrain-driven winds and differences in the modelled windroses.

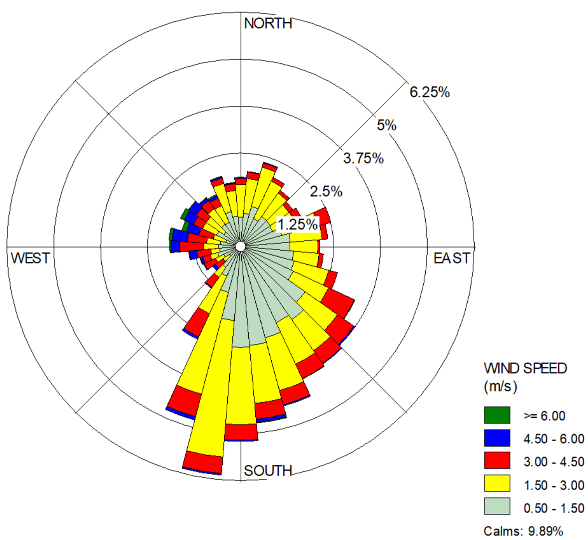
There is one (1) closest meteorological station to the proposed site. The St. Mary's Station, which was commissioned in October 1992 and is located on residential property off Mamre Road, St Mary's. It is situated in the center of the Hawkesbury basin in a semi-rural area. St. Mary's Station is 2 km north-east of the proposed site. Observations of wind speed and direction recorded at the St. Mary's Air Quality Monitoring Station (AQMS) have been used to describe typical wind patterns in the area surrounding the Proposal site. St. Mary's AQMS are operated by the NSW Department of Planning, Industry and Environment (DPIE). There is also a metrological station at the site (Patons Lane Weather Station SN16594) which is located -33.82° Latitude, 150.74° Longitude.

The annual windroses for the year 2018 are shown in Figure A.3, Figure A.4 and Figure A.5 at St. Mary's AQMS, Penrith Lakes Station and Patons Lane Weather Station SN16594, respectively. A modelled wind rose for the facility is shown in Figure A.6, reflecting that most of the winds through this region are largely blow towards Southwest quadrants. The wind roses presented illustrate generally good agreement between the predicted and observed wind conditions through the full year and seasonal analysis. The frequency of directionality characteristics is largely seen to vary less so than the magnitude of the frequency of winds from certain wind speed classes. Modelled surface wind roses match closely at the St. Mary's AQMS and the Patons Lane Weather Station SN16594.



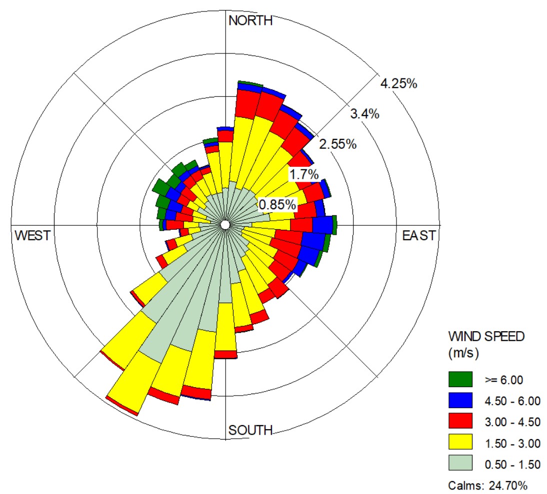
St. Mary's Station CALMET Modelled Windrose plot

Figure A.3: Modelled annual wind roses at St. Mary's AQMS (2018).



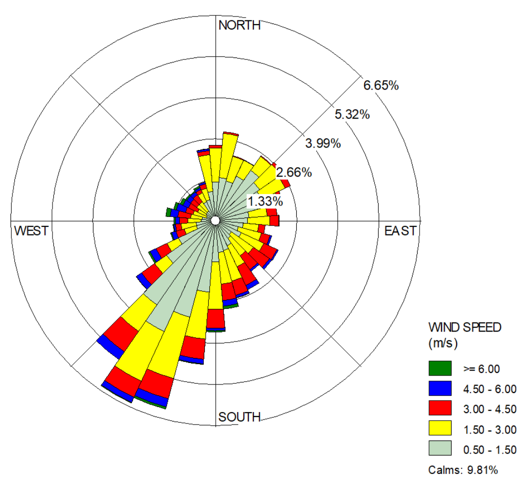
Penrith Lakes Station CALMET Modelled Windrose plot

Figure A.4: Modelled annual wind roses at Penrith Lakes (2018).



Patons Lane Weather Station Observed Windrose plot

Figure A.5: Observed annual wind rose at Patons Lane Weather Station SN16594 (2018).



Modelled Windrose plot At Facility

Figure A.6: Modelled annual wind rose at the Facility (2018).

A.3.2.1. Pasquill-Gifford Stability Class

In CALMET, the Pasquill-Gifford stability scheme is used to classify atmospheric stratification in the boundary layer over land. These classes range from unstable (Classes A, B and C), through neutral (Class D) to stable (Classes E and F). Normally, unstable conditions are associated with daytime, ground-level heating, which results in thermal turbulence activity in the boundary layer. Stable conditions are primarily associated with night-time cooling, which results in the suppression of the turbulence levels and temperature inversion at lower levels. Neutral conditions are mostly associated with high wind speeds or overcast sky conditions.

The frequency distributions of CALMET-derived Pasquill-Gifford stability classes for the Paton Lane Resource Recovery facility is shown in Figure A.7. The most frequent stability class is Class D or neutral. This is a result of the frequency of overcast sky conditions. Very stable conditions (category F) are nearly less than half of neutral conditions, while very unstable conditions (category A) are rare.

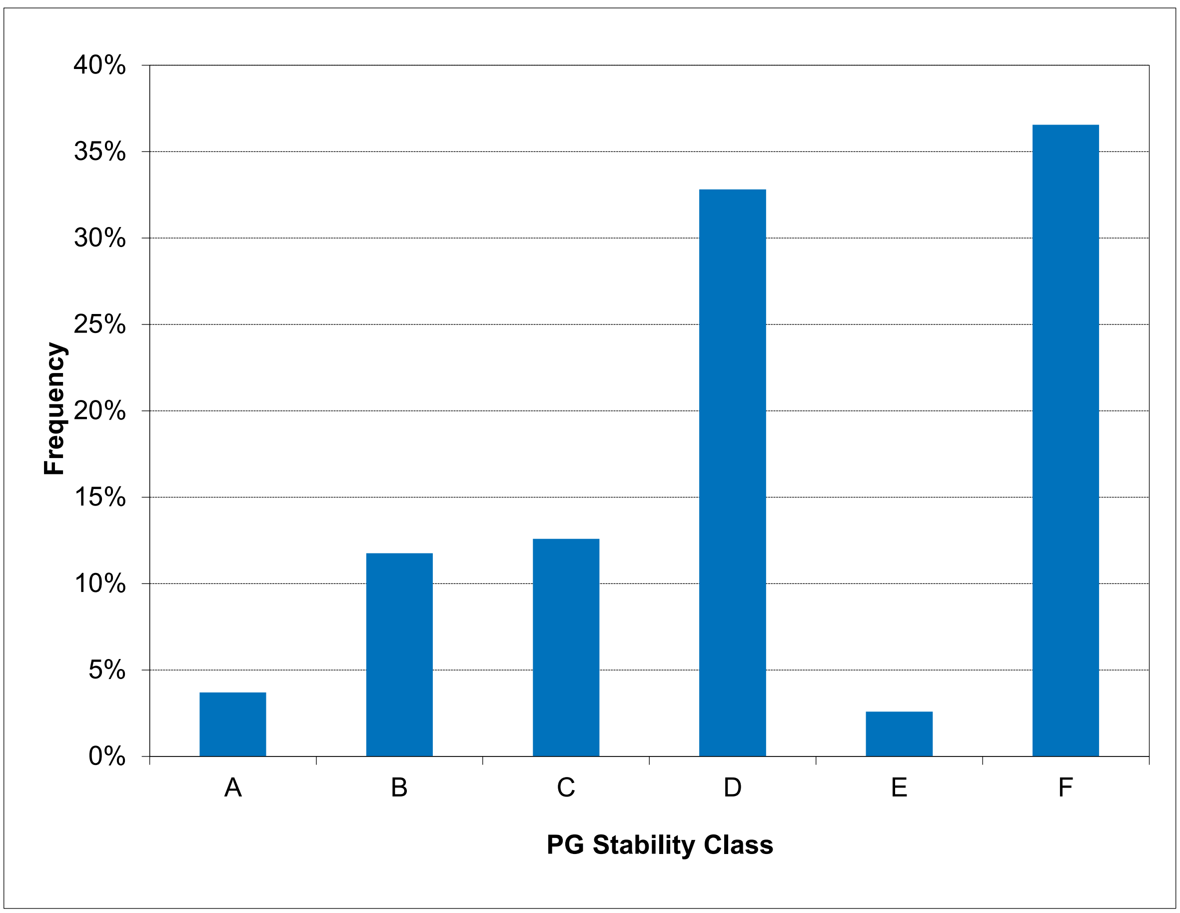


Figure A.7: Frequency of modelled Pasquill-Gifford stability classes at Patons Lane Resource Recovery Facility.

A.3.3. Modelled Wind Fields

Winds in the study area result from a combination of large-scale synoptic patterns and thermal circulations (land-sea breezes), TAPM winds, at 1 km resolution, capture the synoptic and thermal circulations well, and some of the terrain-induced circulations (to the extent they are resolved at the TAPM spatial resolution of 1 km). CALMET refines the terrain effects further at the finer scale of 200 m used in the current modelling.

CALMET-derived wind fields follow the expected terrain flows under various stability and flow regimes., A light sea breeze penetration can be seen midday in the summer near the surface. Under neutral conditions, the characteristic high wind speeds result in less noticeable terrain effects and wind fields reflect larger mesoscale wind patterns across the model domain. Under stable conditions, the winds are highly variable in direction and strength.

A.3.3.1. Mixing Heights

Mixing heights are estimated in CALMET through methods that are based on either surface heat flux (thermal turbulence) and vertical temperature profiles, or friction velocities (mechanical turbulence). Table A.3 shows the average modelled mixing heights by Pasquill-Gifford stability class. Overall, the highest mixing heights are associated with unstable conditions (Classes A, B and C), while the lowest mixing heights are associated with stable conditions (Classes E and F), when both convective and mechanical turbulence are at their lowest.

Table A.3: Average modelled mixing height by Pasquill-Gifford Stability Class (in m) extracted at the facility location.

Station	A	B	C	D	E	F
Facility	1000	752	660	528	177	58

A.3.3.2. Surface temperature

The monthly minimum, maximum and average CALMET temperatures at the Facility are included in Figure A.9; Peak summer months temperatures were a bit higher in 2018, and minimum temperatures a bit colder than their respective long-term average.

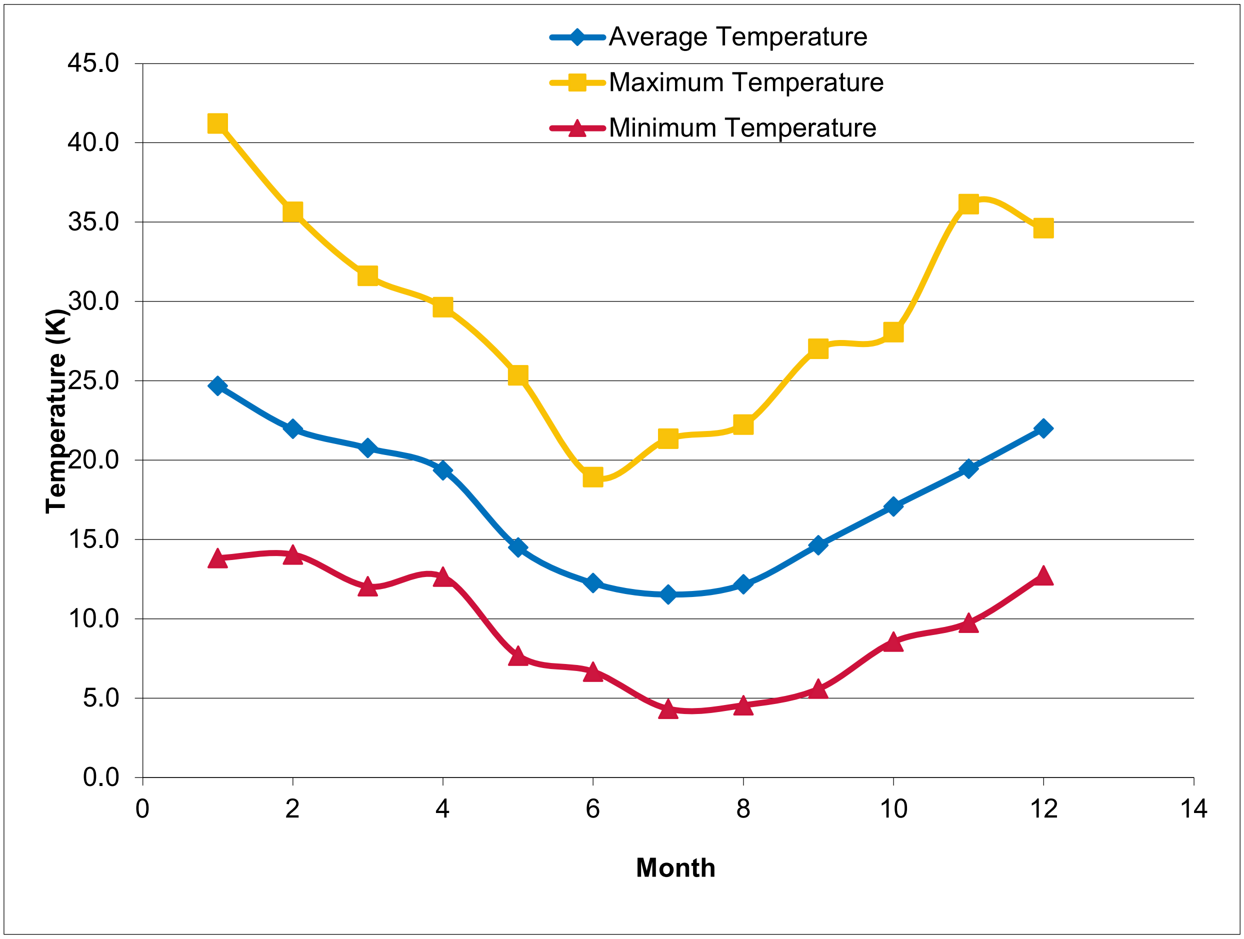


Figure A.8: Monthly distribution of average (blue curve) CALMET surface temperature at the Facility (2018).

APPENDIX B

EMISSIONS INVENTORY

Appendix B1: Hauling Roads Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

UNPAVED ROAD SECTIONS - AP-42 Section 13.2.2

PAVED ROAD SECTIONS - AP-42 Section 13.2.1

Paved Roads: $E = k\,(sL)^{0.91}\,(W)^{1.02}$

Unpaved Roads - Industrial: $E = 281.9\,k\,(s / 12)^{a}\,(W / 3)^{b}$

Unpaved Roads - Public: $E = 281.9\,k\,(s / 12)^{a}\,(S / 30)^{d} / (M / 0.5)^{c} - C$

E particulate emission factor (g/VKT)
k particle size multiplier (see below)
sL road surface silt loading (g/m^2)
W average weight of the vehicles traveling the road (US short tons)
s surface material silt content (%)
C emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear
M surface material moisture content (%)
S mean vehicle speed (mph)
a,b,c,d constants (see below)

Activity	Vehicle Type	Traffic Passes [2] Daily (#/d)	Weekly (#/w)	Monthly (#/m)	Segment Length [2] (m)	Road Surface [3]	Roadway Type [4]	Mean Vehicle Speed (km/h)	(mph)	Average Vehicle Weight [5] (tons)	Surface Material Moisture Content [6] (%)	Surface Silt Content [7] (%)	Road Surface Silt Loading [8] (g/m^2)	Water Control (%)	Base AP-42 Emission Factor TSP (g/VKT)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	Base Emission Rate TSP (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)
B - Hauling Waste for recycling (Recycling & reprocessing Area – Unsealed Road)	Heavy Trucks	19	115	462	1170	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	217.0	8.6E+00	8.6E-01	3.39E-02	1.34E-03	1.34E-04
B - Hauling Waste for recycling (Recycling & reprocessing Area – Sealed Road)	Heavy Trucks	19	115	462	1130	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	5.08E-04	7.31E-05	1.77E-05
A - Hauling Waste (Emplacing in Cell 2) (Sealed Road)	Heavy Trucks	19	115	462	920	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	4.14E-04	5.35E-05	1.30E-05
A - Hauling Waste (Emplacing in Cell 2) (Unsealed Road)	Heavy Trucks	19	115	462	240	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	2.2E+02	8.6E+00	8.6E-01	6.96E-03	2.75E-04	2.75E-05
D - Scraper Travelling	Scraper	4	24	95	11060	Unpaved	Industrial	25	16	56.79		5.0%	0.015	75.0%	2.9E+02	1.1E+01	1.1E+00	8.77E-02	3.47E-03	3.47E-04
F - Hauling Clay/Shale Material (Unsealed Road)	Heavy Trucks	19	115	462	580	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	2.2E+02	8.6E+00	8.6E-01	1.68E-02	6.65E-04	6.65E-05
F - Hauling Clay/Shale Material (Sealed Road)	Heavy Trucks	19	115	462	560	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	2.52E-04	3.26E-05	7.89E-06
H - Hauling Drainage Aggregates (Unsealed Road)	Heavy Trucks	19	156	624	940	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	2.2E+02	8.6E+00	8.6E-01	2.72E-02	1.08E-03	1.08E-04
H - Hauling Drainage Aggregates (Sealed Road)	Heavy Trucks	19	156	624	560	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	2.52E-04	3.26E-05	7.89E-06
Hauling Recycled material Off-Site	Heavy Trucks	19	115	462	1130	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	5.08E-04	6.58E-05	1.59E-05
Hauling Recycled material to Cell 2 (Sealed Roads)	Heavy Trucks	19	115	462	240	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	1.08E-04	1.40E-05	3.38E-06
Hauling Recycled material to Cell 2 (Unsealed Roads)	Heavy Trucks	19	115	462	920	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	2.2E+02	8.6E+00	8.6E-01	2.67E-02	1.06E-03	1.06E-04
J - Hauling Clay-Capping (Cell 1 – Unsealed Road)	Heavy Trucks	19	60	238	1570	Unpaved	Industrial	25	16	30		5.0%	0.015	75.0%	2.2E+02	8.6E+00	8.6E-01	4.55E-02	1.80E-03	1.80E-04
J - Hauling Clay-Capping (Cell 1 – Sealed Road)	Heavy Trucks	19	60	238	240	Paved	Industrial	25	16	30		5.0%	0.015	75.0%	3.4E+00	4.4E-01	1.1E-01	1.08E-04	1.55E-05	3.75E-06

Constants for Mobile Emission Equations

Roadway Type	Contaminant	k	a	b	c	d	Quality
Paved Roads:	$PM_{2.5}$	0.15	-	-	-	-	-
	PM_{10}	0.62	-	-	-	-	-
	PM_{30}	3.23	-	-	-	-	-
	TSP	4.79	-	-	-	-	-
Unpaved Roads - Industrial:	$PM_{2.5}$	0.15	0.9	0.45	-	-	C
	PM_{10}	1.5	0.9	0.45	-	-	B
	PM_{30}	4.9	0.7	0.45	-	-	B
	TSP	7.32	0.6	0.45	-	-	C
Unpaved Roads - Public:	$PM_{2.5}$	0.18	1	-	0.2	0.5	C
	PM_{10}	1.8	1	-	0.2	0.5	B
	PM_{30}	6	1	-	0.3	0.3	B
	TSP	8.96	1	-	0.49	0.2	C

Comments

Constants for TSP (PM44) extrapolated from published factors for PM30, PM10 and PM2.5. Data quality downgraded by one step.

Hours per day 10

[2] Length of a specific road segment. A separate segment should be used whenever one or more parameters change.
[3] Paved surfaces include asphalt, concrete, and recycled asphalt (if it forms a relatively consistent surface).
[4] Publicly accessible and dominated by light vehicles, or industrial, and dominated by heavy vehicles.
[5] The average vehicle weight reflects the average of the empty and loaded vehicle weight, for travel in both directions.
[6] Required only for publicly accessible unpaved roads.
[7] Required only for unpaved roads (public and industrial)
[8] Required only for industrial paved roads.

Sample calculation for uncontrolled TSP emission factor for Activity B - Hauling Waste for recycling (Recycling & reprocessing Area – Unsealed Road): Heavy Trucks

EF = 281.9 x 7.32 x (6.9 /12)^(0.6) x (30/3)^(0.45) = 217 g TSP / vehicle kilometer travelled (vkt) 217.01

Sample calculation for TSP emission rate for Activity B - Hauling Waste for recycling (Recycling & reprocessing Area – Unsealed Road): Heavy Trucks

19 vehicles	1170 m	1 km	217 g_{TSP}	1.00 day	1 hr	25.00 Water Control		0.03391
1 day		1000 m	1 vehicle km	10 hr	3600 s	100	=	3.39E-02 g_{TSP} / s

Appendix B2: Loading / Unloading / Transferring Material Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

US EPA emission factor (US EPA, 1985 and updates)

$$E[kg/t] = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2.0}\right)^{1.4}}\right)$$

k = 0.74 for TSP, 0.35 for PM10 and 0.053 for PM2.5
U = wind speed [ms-1]
M = moisture content [%]

Activity	Max Wind Speed	Moisture Content	Water Control	Base AP-42 Emission Factor			Base Emission Rate		
				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
	(m/s)	(%)	(%)	(kg/t)	(kg/t)	(kg/t)	(g/s)	(g/s)	(g/s)
B - Emplacing Waste for Recycling (Dumping Waste For Recycling)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	2.41E-01	1.14E-01	1.73E-02
A - Emplacing Waste for Landfill (Dumping Waste)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	6.90E-02	3.26E-02	4.94E-03
C - Excavator/Compactor on Waste (Cell 2)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	6.90E-02	3.26E-02	4.94E-03
E - Excavator (Cell 3)	1.9	4.0		3.63E-04	1.72E-04	2.60E-05	6.01E-03	2.84E-03	4.30E-04
F - Front End Loader (FEL) (Clay/Shale in Cell 3)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	1.10E-01	5.22E-02	7.91E-03
H - Emplacing Drainage Aggregates (Cell 2)	1.9	4.0		3.63E-04	1.72E-04	2.60E-05	5.63E-04	2.66E-04	4.03E-05
I - Front End Loader (FEL) (Recycling & Reprocessing area Cell)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	2.41E-01	1.14E-01	1.73E-02
Front End Loader (FEL) Recycled material (Recycling & Reprocessing area Cell)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	2.41E-01	1.14E-01	1.73E-02
Emplacing Waste (Dumping Waste - Cell 2)	1.9	0.5		6.68E-03	3.16E-03	4.78E-04	6.90E-02	3.26E-02	4.94E-03
J - Emplacing Clay-capping (Cell 1)	1.9	6.0		2.06E-04	9.74E-05	1.47E-05	2.13E-03	1.01E-03	1.52E-04
K - Compactor (Cell 1)	1.9	4.0		3.63E-04	1.72E-04	2.60E-05	2.34E-02	1.11E-02	1.68E-03

Constants Emission Equations

Contaminant	k
$PM_{2.5}$	0.053
PM_{10}	0.35
PM_{30}	0.74
TSP	0.74

Annual throughput [t]	450,000	tons/year
Emplacing Waste for Recycling [t]	350,000	tons/year
Emplacing Waste for Landfill [t]	100,000	tons/year
Annual Clay/Shale Excavated/dispatched [t]	160,000	tons/year
Emplacing Drainage Aggregates [t]	15,000	tons/year
Waste for Compactor [t]	624,000	tons/year

Sample calculation for uncontrolled TSP emission factor for Activity B - Emplacing Waste for Recycling (Dumping Waste For Recycling)

EF = 0.74 x 0.0016 x ((1.9/12)^(1.3))/(0.5/2.0)^(1.4)) = 6.68E-03 kg TSP / ton (material)

Sample calculation for TSP emission rate for Activity B - Emplacing Waste for Recycling (Dumping Waste For Recycling)

6.68E-03 kg_{TSP}	1000 g	350000 ton	1 year	1.00 week	1 hr		
1 ton	kg	1 year	48 weeks	56 hours	3600 s	=	2.41E-01 g_{TSP} / s

Appendix B3: Dozer Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

US EPA emission factor (US EPA, 1985 and updates)

Dozer Emissions: $E = 2.6\ (s)^{1.2} / (M)^{1.3}$

s = silt content (%)
M = moisture content [%]

Activity	Silt Content	Moisture Content	Water Control	Base AP-42 Emission Factor			Base Emission Rate		
				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
	(%)	(%)	(%)	(kg/hr)	(kg/hr)	(kg/hr)	(g/s)	(g/s)	(g/s)
K - Dozer shaping (Cell 1)	5.0	4.0		2.96E+00	1.18E+00	1.78E-01	8.22E-01	3.29E-01	4.93E-02

[1] PM10 emissions are 0.40 x TSP emissions

[2] PM2.5 emissions are 0.15 x PM10 emissions

Sample calculation for uncontrolled TSP emission factor for Activity K - Dozer shaping (Cell 1)

EF = 2.6 x ((5.0)^(1.2))/(4.0)^(1.3))) = 2.96E+00 kg TSP / hr

Sample calculation for TSP emission rate for Activity K - Dozer shaping (Cell 1)

$$\frac{2.96\text{E}+00\ \text{kg}_{TSP}}{1\ \text{hr}} \times \frac{1000\ \text{g}}{\text{kg}} \times \frac{1\ \text{hr}}{3600\ \text{s}} = 8.22\text{E-}01\ \text{g}_{TSP} / \text{s}$$

Appendix B4: Scraper Removing Material and Unloading Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

US EPA emission factor (US EPA, 1985 and updates - Table 11.9-4 - Scraper Removal and Unloading)

Activity	Material Tonnage	Base AP-42 Emission Factor			Base Emission Rate		
		TSP	PM_{10} [1]	$PM_{2.5}$ [2]	TSP	PM_{10}	$PM_{2.5}$
	(t/year)	(kg/t)	(kg/t)	(kg/t)	(g/s)	(g/s)	(g/s)
D - Scraper (Cell 2 + 3) removing Material	624000	2.90E-02	1.16E-02	1.74E-03	1.87E+00	7.48E-01	1.12E-01
D - Scraper (Cell 2 + 3) Unloading Material	624000	2.00E-02	8.00E-03	1.20E-03	1.29E+00	5.16E-01	7.74E-02

[1] PM10 emissions are 0.40 x TSP emissions

[2] PM2.5 emissions are 0.15 x PM10 emissions

Sample calculation for TSP emission rate for Activity D - Scraper (Cell 2 + 3) removing Material

$$\frac{2.90\text{E-}02\ kg_{TSP}}{1\ ton} \times \frac{1000\ g}{kg} \times \frac{624000\ ton}{1\ year} \times \frac{1\ year}{48\ weeks} \times \frac{1.00\ week}{56\ hours} \times \frac{1\ hr}{3600\ s} = 1.87\text{E+}00\ g_{TSP}/s$$

Appendix B5: Crushing / Screening Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

US EPA emission factor (US EPA, 1985 and updates - Table 11.19.2-2)

Activity	Crushed Tonnage	Base AP-42 Emission Factor			Base Emission Rate		
		TSP	PM_{10}	$PM_{2.5}$ [1]	TSP	PM_{10}	$PM_{2.5}$
	(t/year)	(kg/t)	(kg/t)	(kg/t)	(g/s)	(g/s)	(g/s)
Screening (Recycling & Reprocessing Area)	150000	1.25E-02	4.30E-03	6.45E-04	2.17E-01	7.47E-02	1.12E-02

[1] PM2.5 emissions are 0.15 x PM10 emissions

Sample calculation for TSP emission rate for Activity Screening (Recycling & Reprocessing Area)

$$\frac{1.25\text{E-02 kg}_{TSP}}{1\ \text{ton}} \times \frac{1000\ \text{g}}{\text{kg}} \times \frac{150000\ \text{ton}}{1\ \text{year}} \times \frac{1\ \text{year}}{48\ \text{weeks}} \times \frac{1.00\ \text{week}}{56\ \text{hours}} \times \frac{1\ \text{hr}}{3600\ \text{s}} = 1.94\text{E-01}\ \text{g}_{TSP} / \text{s}$$

Annual throughput [t]	60000
Block tonnage	54000
Crushed tonnage	6000

Appendix B6: Wind Erosion Emissions

Based on AP-42 Chapter 13.2.5, November 2006

Scenario A - Approved Worst-Case Operations

Met Data Set / Year: 2018 Met Year Data

Default Values	**Wind Erosion from Facility**	**Annual Total**	**Base Emission Rate**
Pile Description	Wind erosion from exposed area including stockpiles	**(kg)**	**(g/s)**
Threshold Friction Velocity (m/s)	0.1	- -	- -
K Factor TSP	1	- -	- -
K Factor PM_{10}	0.5	- -	- -
K Factor $PM_{2.5}$	0.075	- -	- -
Disturbances / day [1]	1	- -	- -
Disturbed Area (m^2) [2]	250000	- -	- -
TSP Annual Emissions (kg/year)	104437	**104437**	**3.31.E+00**
PM_{10} Annual Emissions (kg/year)	52218	**52218**	**1.66.E+00**
$PM_{2.5}$ Annual Emissions (kg/year)	7833	**7833**	**2.48.E-01**

AP-42 Table 13.2.5-2: Threshold Friction Velocities

Material	**Threshold Friction Velocity (m/s)**	**Roughness Height (cm)**	**Threshold Wind Velocity At 10 m (m/s)**	
			z_o = Act	**z_o = 0.5 cm**
Overburden [a]	1.02	0.3	21	19
Scoria (roadbed material) [a]	1.33	0.3	27	25
Ground coal (surrounding coal pile) [a]	0.55	0.01	16	10
Uncrusted coal pile [a]	1.12	0.3	23	21
Scraper tracks on coal pile [a,b]	0.62	0.06	15	12
Fine coal dust on concrete pad [c]	0.54	0.2	11	10

a Western surface coal mine. Reference 2.

b Lightly crusted.

c Eastern power plant. Reference 3.

Notes:

[1] As a worst-case, assume a minimum of one disturbance per day, enter other values if known.

[2] Five percent (5%) of the surface area of the storage piles were assumed to be disturbed in a given day.

[3] NMOC values are predicted for those erosion sources which contain contaminated soil. Since contaminated soil is used as daily cover, the working face and mound were assumed to be composed of contaminated soil.

[4] Surface Friction Velocity: $u^* = 0.053 \times u{+}10$

[5] Erosion Potential: $P = 58(u^* - u^*t)^2 + 25(u^* - u^*t)$

Appendix B7: Summary of Emission Inventory (BY Activity)

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

Activity ID	Source ID's	Activity	Total Emissions (kg/year)			Base Emission Rate (g/s)		
			TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
B	VOL1, VOL2, VOL3	B - Hauling Waste for recycling (Recycling & reprocessing Area – Sealed Road)	4.9	0.7	0.2	5.08E-04	7.31E-05	1.77E-05
B	VOL4, VOL5, VOL6	B - Hauling Waste for recycling (Recycling & reprocessing Area – Unsealed Road)	328.1	13.0	1.3	3.39E-02	1.34E-03	1.34E-04
B	VOL4, VOL5	B - Emplacing Waste for Recycling (Dumping Waste For Recycling)	2,336.4	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
A	VOL2	A - Hauling Waste (Emplacing in Cell 2) (Sealed Road)	4.0	0.5	0.1	4.14E-04	5.35E-05	1.30E-05
A	VOL5, VOL6, VOL7, VOL8, VOL9	A - Hauling Waste (Emplacing in Cell 2) (Unsealed Road)	67.3	2.7	0.3	6.96E-03	2.75E-04	2.75E-05
A	VOL9, VOL10	A - Emplacing Waste for Landfill (Dumping Waste)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
C	VOL9, VOL10	C - Excavator/Compactor on Waste (Cell 2)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
D	VOL11, VOL12, VOL13, VOL14	D - Scraper (Cell 2 + 3) removing Material	18,096	7,238.4	1,085.8	1.87E+00	7.48E-01	1.12E-01
D	VOL4, VOL5, VOL6, VOL7, VOL8, VOL10	D - Scraper Travelling	849	33.6	3.4	8.77E-02	3.47E-03	3.47E-04
D	VOL11, VOL12, VOL13, VOL15	D - Scraper (Cell 2 + 3) Unloading Material	12,480	4,992.0	748.8	1.29E+00	5.16E-01	7.74E-02
E	VOL13, VOL14	E - Excavator (Cell 3)	58	27.5	4.2	6.01E-03	2.84E-03	4.30E-04
F	VOL13, VOL14	F - Front End Loader (FEL) (Clay/Shale in Cell 3)	1,068	505.2	76.5	1.10E-01	5.22E-02	7.91E-03
F	VOL13, VOL14	F - Hauling Clay/Shale Material (Unsealed Road)	163	6.4	0.6	1.68E-02	6.65E-04	6.65E-05
F	VOL1, VOL2	F - Hauling Clay/Shale Material (Sealed Road)	2	0.3	0.1	2.52E-04	3.26E-05	7.89E-06
H	VOL6, VOL7, VOL8, VOL9, VOL10	H - Hauling Drainage Aggregates (Unsealed Road)	264	10.4	1.0	2.72E-02	1.08E-03	1.08E-04
H	VOL1, VOL2	H - Hauling Drainage Aggregates (Sealed Road)	2	0.3	0.1	2.52E-04	3.26E-05	7.89E-06
H	VOL9, VOL10	H - Emplacing Drainage Aggregates (Cell 2)	5	2.6	0.4	5.63E-04	2.66E-04	4.03E-05
I	VOL9, VOL10	I - Front End Loader (FEL) (Recycling & Reprocessing area Cell)	2,336	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
M	VOL4, VOL5	Screening (Recycling & Reprocessing Area)	2,100	722.4	108.4	2.17E-01	7.47E-02	1.12E-02
N	VOL4, VOL5	Front End Loader (FEL) Recycled material (Recycling & Reprocessing area Cell)	2,336	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
O	VOL1, VOL2, VOL3, VOL4, VOL5	Hauling Recycled material Off-Site	5	0.6	0.2	5.08E-04	6.58E-05	1.59E-05
O	VOL2, VOL3	Hauling Recycled material to Cell 2 (Sealed Roads)	1	0.1	0.0	1.08E-04	1.40E-05	3.38E-06
O	VOL4, VOL5, VOL6, VOL7, VOL8, VOL9	Hauling Recycled material to Cell 2 (Unsealed Roads)	258	10.2	1.0	2.67E-02	1.06E-03	1.06E-04
P	VOL9, VOL10	Emplacing Waste (Dumping Waste - Cell 2)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
J	VOL6, VOL7, VOL13, VOL14, VOL15, VOL16, VOL17	J - Hauling Clay-Capping (Cell 1 – Unsealed Road)	440	17.4	1.7	4.55E-02	1.80E-03	1.80E-04
J	VOL2	J - Hauling Clay-Capping (Cell 1 – Sealed Road)	1	0.2	0.0	1.08E-04	1.55E-05	3.75E-06
J	VOL15, VOL16	Emplacing Waste (Dumping Waste - Cell 2)	20.6	9.7	1.5	2.13E-03	1.01E-03	1.52E-04
J	VOL15, VOL16	J - Emplacing Clay-capping (Cell 1)	226.6	107.2	16.2	2.34E-02	1.11E-02	1.68E-03
K	VOL15, VOL16	K - Dozer shaping (Cell 1)	7,952.2	3,180.9	477.1	8.22E-01	3.29E-01	4.93E-02
Q	VOL9, VOL15	Dump to stockpile	667.5	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
R	VOL9, VOL16	Load to customer truck	226.6	107.2	16.2	2.34E-02	1.11E-02	1.68E-03
S	VOL1 to VOL17	Wind Erosion from Exposed Area	104,436.7	52,218.4	7,832.8	3.31E+00	1.66E+00	2.48E-01

Appendix B8: Volume Source Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario A - Approved Worst-Case Operations

Source ID's	Base Emission Rate (g/s)		
	TSP	PM_{10}	$PM_{2.5}$
VOL1	1.953E-01	9.747E-02	1.463E-02
VOL2	1.959E-01	9.755E-02	1.465E-02
VOL3	1.951E-01	9.745E-02	1.462E-02
VOL4	5.752E-01	2.501E-01	3.763E-02
VOL5	5.766E-01	2.502E-01	3.763E-02
VOL6	2.385E-01	9.913E-02	1.478E-02
VOL7	2.272E-01	9.868E-02	1.474E-02
VOL8	2.207E-01	9.843E-02	1.471E-02
VOL9	4.768E-01	2.259E-01	3.404E-02
VOL10	4.394E-01	2.044E-01	3.077E-02
VOL11	9.847E-01	4.134E-01	6.201E-02
VOL12	9.847E-01	4.134E-01	6.201E-02
VOL13	1.058E+00	4.415E-01	6.623E-02
VOL14	7.354E-01	3.125E-01	4.689E-02
VOL15	9.819E-01	4.133E-01	6.202E-02
VOL16	6.367E-01	2.736E-01	4.104E-02
VOL17	2.013E-01	9.766E-02	1.464E-02

Appendix B9: Sand Conveyors / Screening Emissions from proposed RWTP

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario B: Proposed Modification Emissions

US EPA emission factor (US EPA, 1985 and updates - Table 11.19.1-1 and Table 11.19.2-2)

Activity	Tonnage	Base AP-42 Emission Factor			Base Emission Rate		
		TSP	PM_{10}	$PM_{2.5}$ [1]	TSP	PM_{10}	$PM_{2.5}$
	(t/year)	(kg/t)	(kg/t)	(kg/t)	(g/s)	(g/s)	(g/s)
Proposed Sand Conveyors	450000	6.00E-04	2.40E-04	3.60E-05	3.13E-02	1.25E-02	1.88E-03
Screening (Recycling & Reprocessing Area)	450000	1.25E-02	4.30E-03	6.45E-04	6.51E-01	2.24E-01	3.36E-02

[1] PM2.5 emissions are 0.15 x PM10 emissions

Sample calculation for TSP emission rate for Activity Proposed Sand Conveyors

$$\frac{6.00\text{E-}04\ kg_{TSP}}{1\ ton} \times \frac{1000\ g}{kg} \times \frac{450000\ ton}{1\ year} \times \frac{1\ year}{48\ weeks} \times \frac{1.00\ week}{50\ hours} \times \frac{1\ hr}{3600\ s} = 3.13\text{E-}02\ g_{TSP} / s$$

Annual throughput [t] 450000

Appendix B10: Summary of Emission Inventory (BY Activity)

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario B - Approved Worst Case Operations + Proposed Modifications

Activity ID	Source ID's	Activity	Total Emissions (kg/year)			Base Emission Rate (g/s)		
			TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
B	VOL1, VOL2, VOL3	B - Hauling Waste for recycling (Recycling & reprocessing Area – Sealed Road)	4.9	0.7	0.2	5.08E-04	7.31E-05	1.77E-05
B	VOL4, VOL5, VOL6	B - Hauling Waste for recycling (Recycling & reprocessing Area – Unsealed Road)	328.1	13.0	1.3	3.39E-02	1.34E-03	1.34E-04
B	VOL4, VOL5	B - Emplacing Waste for Recycling (Dumping Waste For Recycling)	2,336.4	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
A	VOL2	A - Hauling Waste (Emplacing in Cell 2) (Sealed Road)	4.0	0.5	0.1	4.14E-04	5.35E-05	1.30E-05
A	VOL5, VOL6, VOL7, VOL8, VOL9	A - Hauling Waste (Emplacing in Cell 2) (Unsealed Road)	67.3	2.7	0.3	6.96E-03	2.75E-04	2.75E-05
A	VOL9, VOL10	A - Emplacing Waste for Landfill (Dumping Waste)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
C	VOL9, VOL10	C - Excavator/Compactor on Waste (Cell 2)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
D	VOL11, VOL12, VOL13, VOL14	D - Scraper (Cell 2 + 3) removing Material	18,096	7,238.4	1,085.8	1.87E+00	7.48E-01	1.12E-01
D	VOL4, VOL5, VOL6, VOL7, VOL8, VOL10	D - Scraper Travelling	849	33.6	3.4	8.77E-02	3.47E-03	3.47E-04
D	VOL11, VOL12, VOL13, VOL15	D - Scraper (Cell 2 + 3) Unloading Material	12,480	4,992.0	748.8	1.29E+00	5.16E-01	7.74E-02
E	VOL13, VOL14	E - Excavator (Cell 3)	58	27.5	4.2	6.01E-03	2.84E-03	4.30E-04
F	VOL13, VOL14	F - Front End Loader (FEL) (Clay/Shale in Cell 3)	1,068	505.2	76.5	1.10E-01	5.22E-02	7.91E-03
F	VOL13, VOL14	F - Hauling Clay/Shale Material (Unsealed Road)	163	6.4	0.6	1.68E-02	6.65E-04	6.65E-05
F	VOL1, VOL2	F - Hauling Clay/Shale Material (Sealed Road)	2	0.3	0.1	2.52E-04	3.26E-05	7.89E-06
H	VOL6, VOL7, VOL8, VOL9, VOL10	H - Hauling Drainage Aggregates (Unsealed Road)	264	10.4	1.0	2.72E-02	1.08E-03	1.08E-04
H	VOL1, VOL2	H - Hauling Drainage Aggregates (Sealed Road)	2	0.3	0.1	2.52E-04	3.26E-05	7.89E-06
H	VOL9, VOL10	H - Emplacing Drainage Aggregates (Cell 2)	5	2.6	0.4	5.63E-04	2.66E-04	4.03E-05
I	VOL9, VOL10	I - Front End Loader (FEL) (Recycling & Reprocessing area Cell)	2,336	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
L	VOL4, VOL5, VOL18	Proposed Sand Conveyors	302	121.0	18.1	3.13E-02	1.25E-02	1.88E-03
M	VOL4, VOL5, VOL18	Screening (Recycling & Reprocessing Area)	6,300	2,167.2	325.1	6.51E-01	2.24E-01	3.36E-02
N	VOL4, VOL5	Front End Loader (FEL) Recycled material (Recycling & Reprocessing area Cell)	2,336	1,105.1	167.3	2.41E-01	1.14E-01	1.73E-02
O	VOL1, VOL2, VOL3, VOL4, VOL5	Hauling Recycled material Off-Site	5	0.6	0.2	5.08E-04	6.58E-05	1.59E-05
O	VOL2, VOL3	Hauling Recycled material to Cell 2 (Sealed Roads)	1	0.1	0.0	1.08E-04	1.40E-05	3.38E-06
O	VOL4, VOL5, VOL6, VOL7, VOL8, VOL9	Hauling Recycled material to Cell 2 (Unsealed Roads)	258	10.2	1.0	2.67E-02	1.06E-03	1.06E-04
P	VOL9, VOL10	Emplacing Waste (Dumping Waste - Cell 2)	668	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
J	VOL6, VOL7, VOL13, VOL14, VOL15, VOL16, VOL17	J - Hauling Clay-Capping (Cell 1 – Unsealed Road)	440	17.4	1.7	4.55E-02	1.80E-03	1.80E-04
J	VOL2	J - Hauling Clay-Capping (Cell 1 – Sealed Road)	1	0.2	0.0	1.08E-04	1.55E-05	3.75E-06
J	VOL15, VOL16	Emplacing Waste (Dumping Waste - Cell 2)	20.6	9.7	1.5	2.13E-03	1.01E-03	1.52E-04
J	VOL15, VOL16	J - Emplacing Clay-capping (Cell 1)	226.6	107.2	16.2	2.34E-02	1.11E-02	1.68E-03
K	VOL15, VOL16	K - Dozer shaping (Cell 1)	7,952.2	3,180.9	477.1	8.22E-01	3.29E-01	4.93E-02
Q	VOL9, VOL15	Dump to stockpile	667.5	315.7	47.8	6.90E-02	3.26E-02	4.94E-03
R	VOL9, VOL16	Load to customer truck	226.6	107.2	16.2	2.34E-02	1.11E-02	1.68E-03
S	VOL1 to VOL18	Wind Erosion from Exposed Area	104,436.7	52,218.4	7,832.8	3.31E+00	1.66E+00	2.48E-01

Appendix B11: Volume Source Emissions

123-179 PATONS LANE, ORCHARD HILLS, NSW

Scenario B - Approved Worst Case Operations + Proposed Modifications

Source ID's	Base Emission Rate (g/s)		
	TSP	PM_{10}	$PM_{2.5}$
VOL1	1.845E-01	9.206E-02	1.382E-02
VOL2	1.851E-01	9.214E-02	1.383E-02
VOL3	1.843E-01	9.204E-02	1.381E-02
VOL4	6.833E-01	2.862E-01	4.304E-02
VOL5	6.847E-01	2.863E-01	4.304E-02
VOL6	2.277E-01	9.372E-02	1.397E-02
VOL7	2.164E-01	9.327E-02	1.393E-02
VOL8	2.099E-01	9.302E-02	1.390E-02
VOL9	4.659E-01	2.205E-01	3.323E-02
VOL10	4.285E-01	1.990E-01	2.996E-02
VOL11	9.739E-01	4.080E-01	6.119E-02
VOL12	9.739E-01	4.080E-01	6.119E-02
VOL13	1.047E+00	4.361E-01	6.542E-02
VOL14	7.246E-01	3.071E-01	4.608E-02
VOL15	9.711E-01	4.079E-01	6.121E-02
VOL16	6.259E-01	2.682E-01	4.023E-02
VOL17	1.905E-01	9.225E-02	1.382E-02

Appendix B12: Odour sources and emissions used in the dispersion modelling

Scenario A - Approved Worst-Case Operations

Source	Source	Area	SOER[1]	Odour Emission Rate (OER)	SOER with peak-to-mean (OU.m^3/m^2/s)			
ID's		(m^2)	(OU.m^3/m^2/s)	(OU.m^3/s)	Pasquill–Gifford stability class - A, B, C, D Near-field P/M60[2] (2.5)	Pasquill–Gifford stability class - A, B, C, D Far-field P/M60[2] (2.3)	Pasquill–Gifford stability class - E, F Near-field P/M60[2] (2.3)	Pasquill–Gifford stability class - E, F Far-field P/M60[2] (1.9)
CELL1	Capped areas – Cell 1	31,507.5	0.0059	184.3	0.015	0.013	0.013	0.011
CELL2A	Capped areas – Cell 2	88,627.5	0.0059	518.5	0.015	0.013	0.013	0.011
LCHT1	Leachate in Cell 1	5,056.0	0.0220	111.2	0.055	0.051	0.051	0.042
EXLCHT1	Existing Leacheate Dam 1	4,026.9	0.0220	88.6	0.055	0.051	0.051	0.042

1 - SOER = Specific Odour Emission Rate, 5% of estimated average odour emissions from standard Class 2 landfills (0.117 OU.m^3/m^2/sec)

SOER for Leachate Dam and proposed treatment plant is assumed same as the previous AQ Assessment report

2 - Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

Appendix B13: Odour sources and emissions used in the dispersion modelling

Scenario B - Approved Worst-Case Operations + Proposed Modifications

Source ID's	Source	Area (m^2)	SOER[1] ($OU.m^3/m^2/s$)	Odour Emission Rate (OER) ($OU.m^3/s$)	SOER with peak-to-mean ($OU.m^3/m^2/s$) Pasquill–Gifford stability class - A, B, C, D Near-field P/M60[2] (2.5)	Pasquill–Gifford stability class - A, B, C, D Far-field P/M60[2] (2.3)	Pasquill–Gifford stability class - E, F Near-field P/M60[2] (2.3)	Pasquill–Gifford stability class - E, F Far-field P/M60[2] (1.9)
CELL1	Capped areas – Cell 1	31,507.5	0.0059	184.3	0.015	0.013	0.013	0.011
CELL2A	Capped areas – Cell 2	88,627.5	0.0059	518.5	0.015	0.013	0.013	0.011
LCHT1	Leachate in Cell 1	5,056.0	0.0220	111.2	0.055	0.051	0.051	0.042
EXLCHT1	Existing Leacheate Dam 1	4,026.9	0.0220	88.6	0.055	0.051	0.051	0.042
PRWTP	Proposed Recycled Water Treatment Plant	1,412.3	0.0220	31.1	0.055	0.051	0.051	0.042
PLCHT	Proposed Leachate Treatment Plant	1,475.2	0.0220	32.5	0.055	0.051	0.051	0.042
PLCHTD1	Proposed Leachate Dam	10,218	0.0220	224.8	0.055	0.051	0.051	0.042

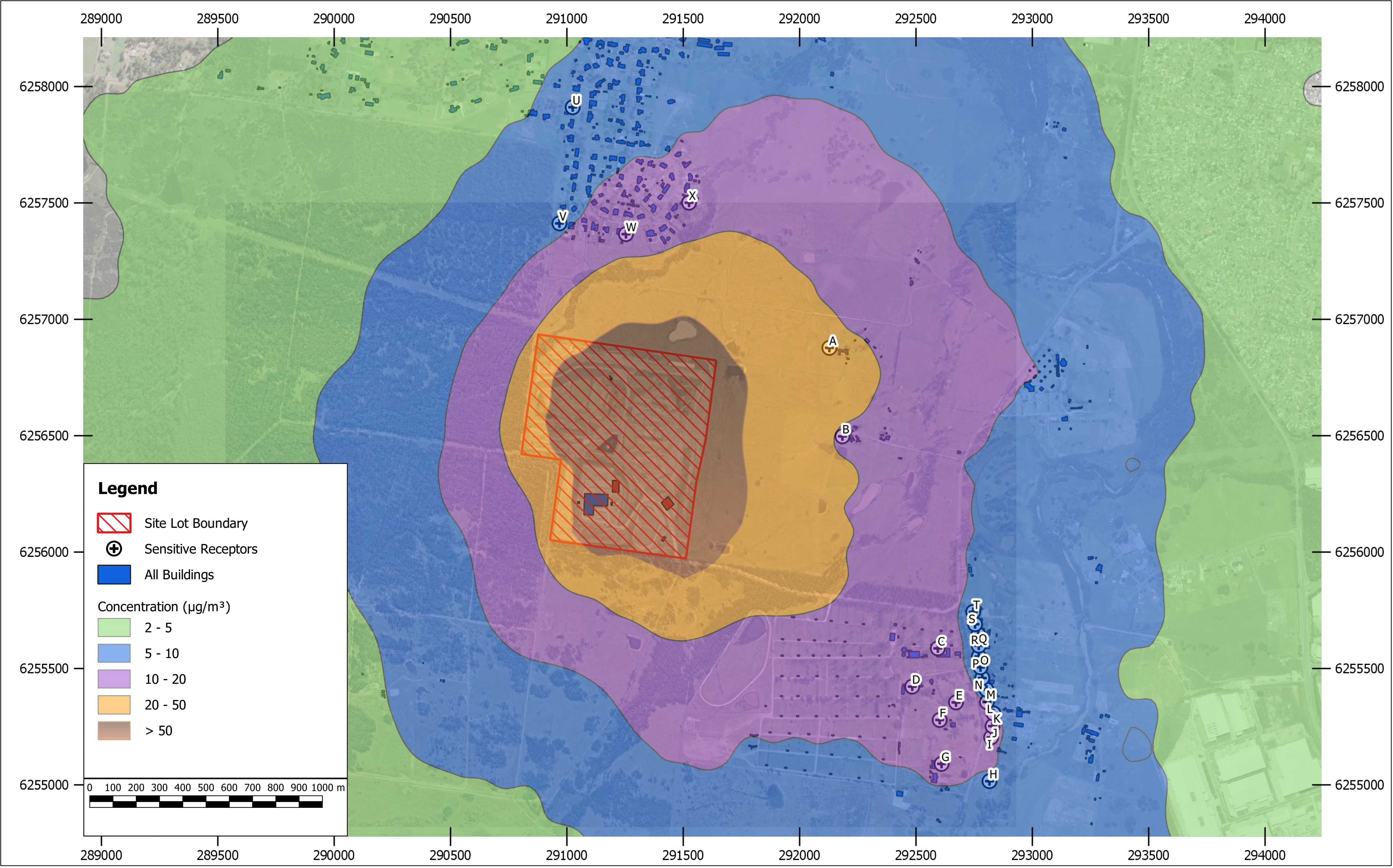
1 - SOER = Specific Odour Emission Rate, 5% of estimated average odour emissions from standard Class 2 landfills (0.117 $OU.m^3/m^2/sec$)

SOER for Leachate Dam and proposed treatment plant is assumed same as the previous AQ Assessment report

2 - Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

APPENDIX C

CONTOUR PLOTS 24-HOUR AVERAGE INCREMENTAL PM_{10} AND $PM_{2.5}$



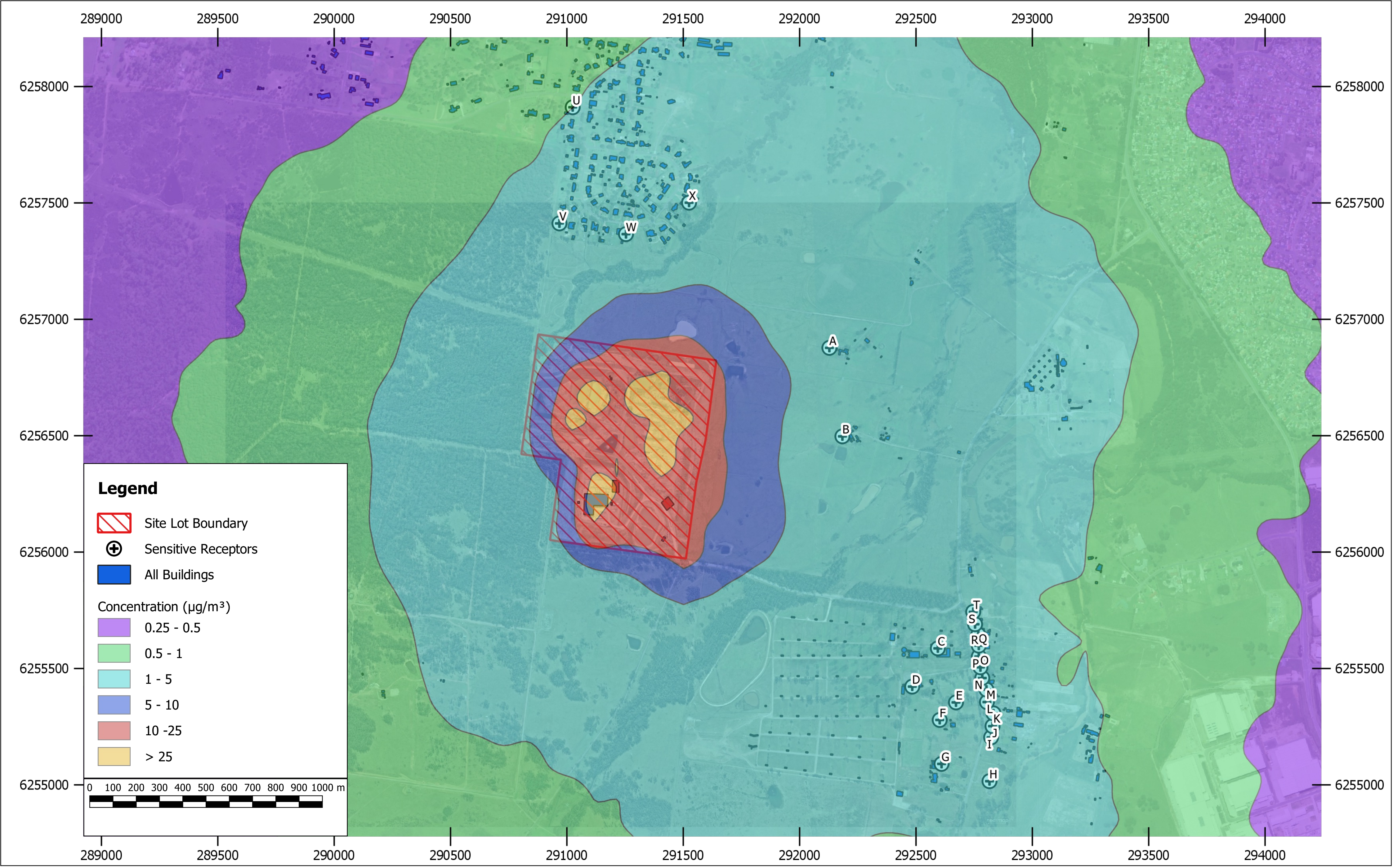
PATONS LANE RESOURCE RECOVERY FACILITY
Contour Plots 24-Hour Average Incremental PM10 - Scenario A (Approved Worst-Case Operations)
Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

N

Revised on: 12/12/2022	
Project #: 2205770	Figure: Appendix C-1
Drawn by: RAMA ROBBI	Checked by:



PATONS LANE RESOURCE RECOVERY FACILITY
Contour Plots 24-Hour Average Incremental PM25 - Scenario A (Approved Worst-Case Operations)
Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

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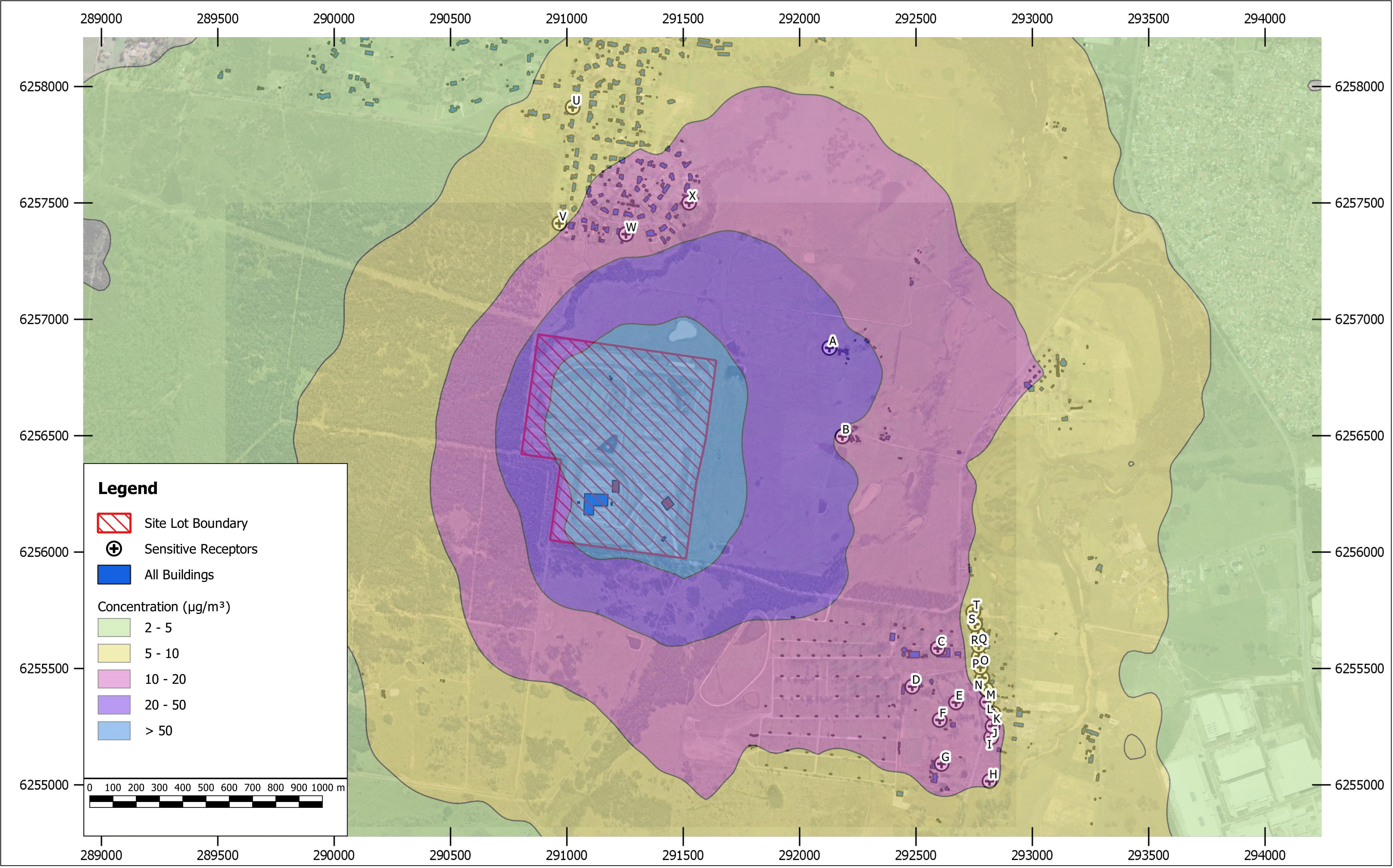
Revised on: 12/12/2022	
Project #: 2205770	Figure: Appendix C-2
Drawn by: RAMA ROBBI	Checked by:

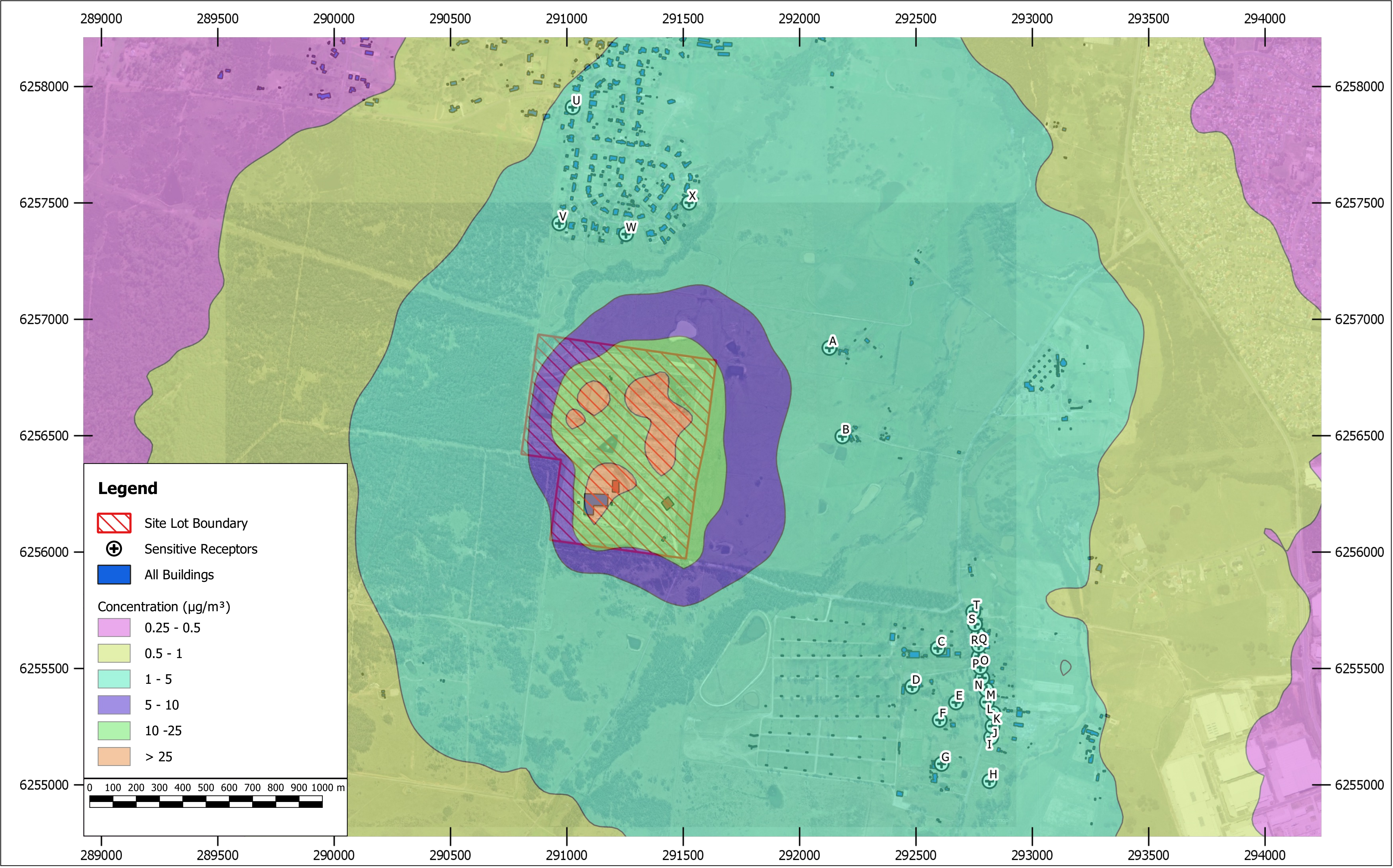


PATONS LANE RESOURCE RECOVERY FACILITY
Contour Plots 24-Hour Average Incremental PM10 - Scenario B (Approved Worst-Case Operations + Proposed Modifications)
Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

Revised on: 12/12/2022	
Project #: 2205770	Figure: Appendix C-3
Drawn by: RAMA ROBBI	Checked by:



PATONS LANE RESOURCE RECOVERY FACILITY

Contour Plots 24-Hour Average Incremental PM25 - Scenario B (Approved Worst-Case Operations + Proposed Modifications)

Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

N

Revised on: 12/12/2022

Project #: 2205770

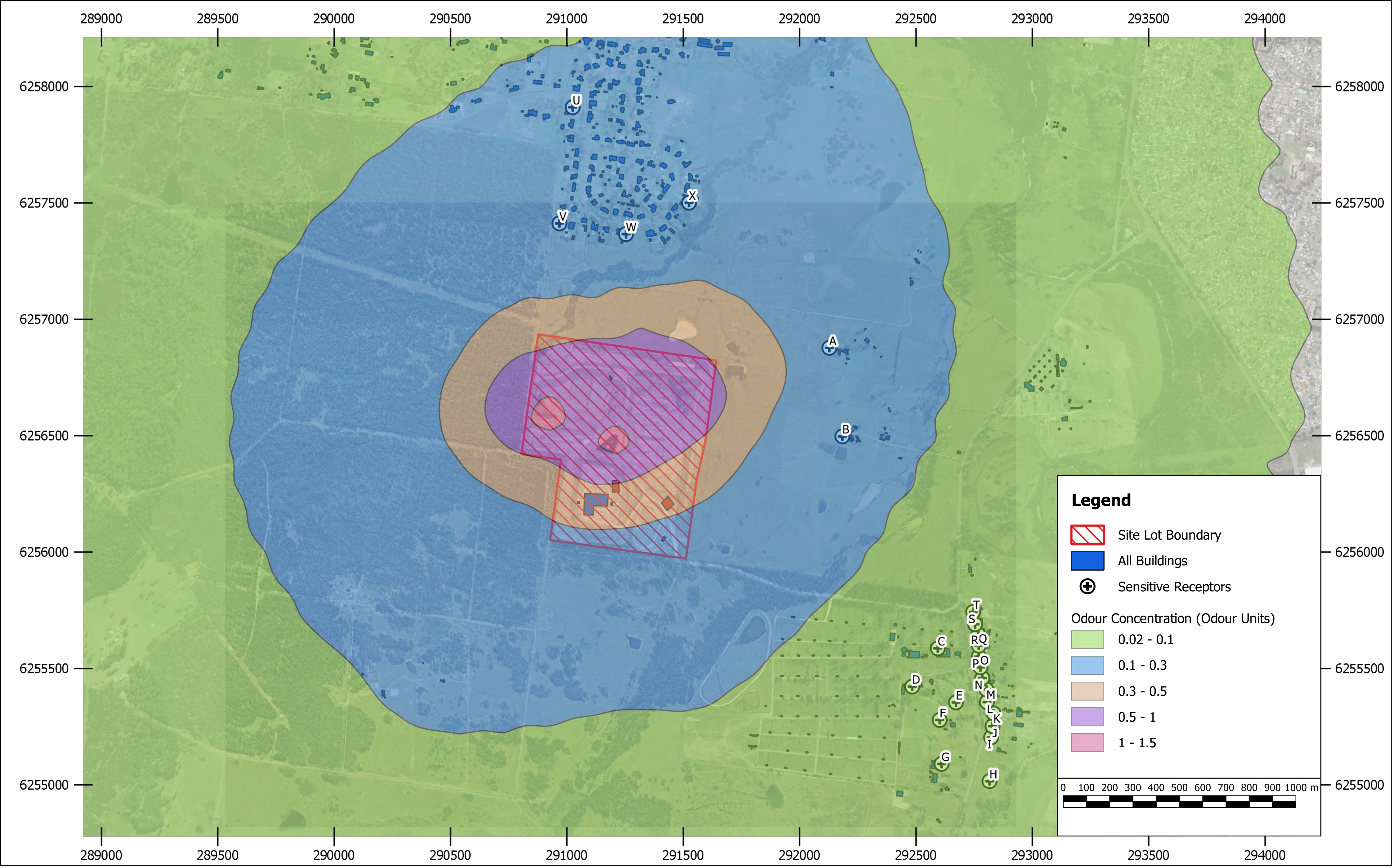
Figure: Appendix C-4

Drawn by: RAMA ROBBI

Checked by:

APPENDIX D

CONTOUR PLOTS 1-HOUR AVERAGE 99TH PERCENTILE ODOUR CONCENTRATION



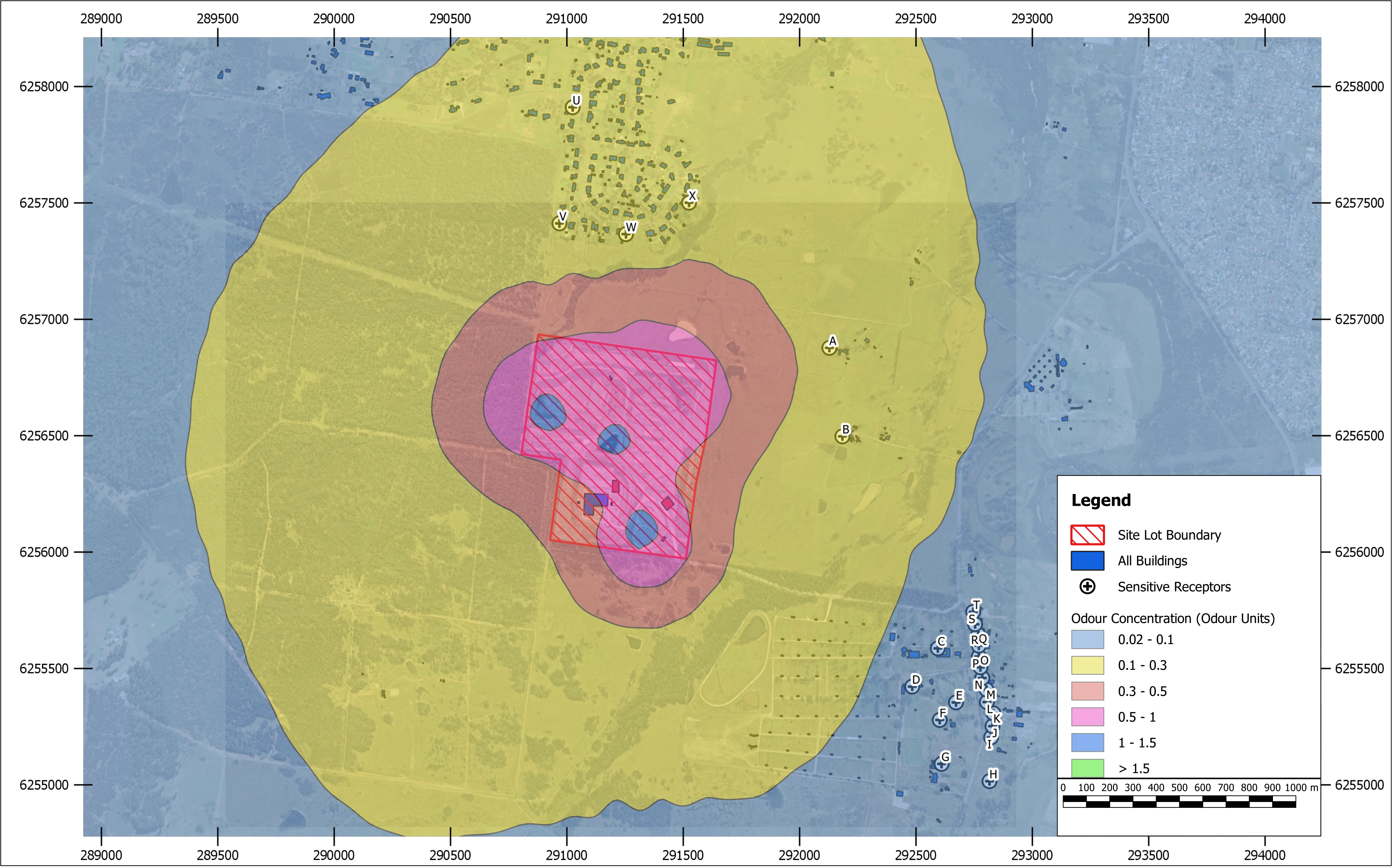
PATONS LANE RESOURCE RECOVERY FACILITY
Contour Plots 1-Hour Average 99th Percentile Odour Concentration - Scenario A (Approved Worst-Case Operations)
Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

N

Revised on: 12/12/2022	
Project #: 2205770	Figure: Appendix D-1
Drawn by: RAMA ROBBI	Checked by:



PATONS LANE RESOURCE RECOVERY FACILITY
Contour Plots 1-Hour Average 99th Percentile Odour Concentration - Scenario B
(Approved Worst-Case Operations + Proposed Modifications)
Lot 40 in DP 738126

Sources:
1. Basemap: © 2022 Nearmaps

Map Projection: / (EPSG:7856)

Revised on: 12/12/2022	
Project #: 2205770	Figure: Appendix D-2
Drawn by: RAMA ROBBI	Checked by: