North West Treatment Hub Growth Project (Rouse Hill)

Air Quality Impact Assessment

Final | Revision 0

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Sydney Water

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Document history and status

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Acronyms and definitions

Abbreviation	Definition
BoM	Bureau of Meteorology
BTF	Bio-trickling filter
CALMET	Meteorological model for the CALPUFF air dispersion model
CALPUFF	Computer-based air dispersion model
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DPIE	Department of Planning, Industry and Environment
EPA	NSW Environment Protection Authority
Jacobs	Jacobs Group (Australia) Pty Limited
NEPM	National Environment Protection Measure
NEPC	National Environmental Protection Council of Australia
OEH	Office of Environment and Heritage, now part of the Department of Planning, Industry and Environment
OCU	Odour Control Unit
OU	Odour units
$PM_{2.5}$	Particulate matter with equivalent aerodynamic diameters less than 2.5 microns
PM_{10}	Particulate matter with equivalent aerodynamic diameters less than 10 microns
POEO Act	*Protection of the Environment Operations (POEO) Act 1997*
REF	Review of Environmental Factors
SOER	Specific odour emission rate
TAPM	The Air Pollution Model – a meteorological and air dispersion model developed by CSIRO
TOER	Total odour emission rate
TSP	Total Suspended Particulate matter
WRP	Water Recycling Plant
WWTP	Wastewater Treatment Plant

Executive Summary

This report provides an assessment of the potential air quality impacts of proposed upgrades to the Rouse Hill Water Recycling Plant (WRP) to accommodate the anticipated growth in the Metro Northwest Corridor and North West Growth Area. The proposed upgrades at the Rouse Hill WRP are part of a broader suite of upgrades associated with the North West Treatment Hub Growth Package Upgrades (the Project).

The purpose of this air quality impact assessment is to form part of a Review of Environmental Factors (REF), and the project will be assessed and determined under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The REF is being prepared by Sydney Water.

This report summarises the odour assessment completed at Rouse Hill WRP for the 'growth package' which comprises of upgrades at Rouse Hill WRP to address additional flows and loads to 2036 as a result of growth in the Rouse Hill catchment. It also considers the cumulative impacts of the proposal following changes referred to as compliance upgrades.

In summary, the assessment identified the key air quality issues, characterised the existing air quality and meteorological environment, quantified emissions and used an air dispersion model to simulate the potential impact of the Project on local air quality.

The key potential air quality issues were identified as:

- Dust during construction; and
- Odour during operation.

A detailed review of the existing environment was carried out and the following conclusions were made:

- The prevailing winds in the area are from the north, southwest and southeast.
- There have been historical complaints relating to odour however the operation of the existing plant has not caused adverse odour impacts in the local community in the past three years.

The main conclusions of the assessment were as follows:

- Dust from construction was determined to have limited potential to cause adverse impacts based on the nature, scale and duration of the proposed works. Nevertheless, appropriate environmental safeguards have been identified to minimise impacts.
- The proposed upgrades are unlikely to cause adverse odour impacts during operation based on conservative modelling which showed compliance with the most stringent EPA assessment criteria at the nearest existing and potential private sensitive receptors and residential areas. In addition, the proposed upgrades will likely reduce the intensity and frequency of off-site odour levels relative to existing operations.

Finally, it was noted that the proposed odour control measures are consistent with best practice for odour management at wastewater treatment plants.

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1. Introduction

Sydney Water is planning upgrades to the Castle Hill Water Recycling Plant (WRP), Rouse Hill Water Recycling Plant (WRP) and Riverstone Wastewater Treatment Plant (WWTP) in order to accommodate the anticipated growth in the Metro Northwest Corridor and North West Growth Area. The upgrades will focus on infrastructure associated with the liquid streams at each plant and will include the development of a centralised biosolids facility at Riverstone. The proposed upgrades are being referred to as the North West Treatment Hub Gowth Package Upgrades (the Project).

This report summarises the odour assessment completed at Rouse Hill WRP for the 'growth package' which comprises of upgrades at Rouse Hill WRP to address additional flows and loads to 2036 as a result of growth in the Rouse Hill catchment. It also considers the cumulative impacts of the proposal following changes referred to as compliance upgrades (Jacobs, 2021).

Jacobs Group (Australia) Pty Ltd (Jacobs) has been engaged by Sydney Water to complete an air quality assessment of the Project, as relevant to the Rouse Hill WRP. The purpose of the assessment is to form part of a Review of Environmental Factors (REF), which will be assessed and determined under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The REF is being prepared by Sydney Water.

The air quality impact assessment has been carried out in accordance with relevant guidelines published by the NSW Environment Protection Authority (EPA), namely, the "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2016) (hereafter referred to as the "Approved Methods"). This assessment involved using a computer-based air dispersion model to determine any potential impacts to air quality due to the Project.

The main objectives of this assessment were to:

- Identify potential air quality issues;
- Quantify existing and potential air quality impacts; and
- Identify suitable air quality management measures, as appropriate, to minimise impacts.

The air quality assessment was based on the use of an air dispersion model, CALPUFF (TRC, 2007), to determine concentrations of substances emitted to air due to the Project. Model results have been compared with air quality criteria referred to by the EPA in order to assess the effect that the project may have on the existing air quality environment.

2. Project Description

Castle Hill WRP and Rouse Hill WRP provide wastewater services for Sydney's North West. Together with Riverstone WWTP, the three plants form the North West Treatment Hub, servicing the North West Growth Area (NWGA) and development along the Metro Northwest Growth Corridor (MNGC). Figure 1 shows the plant locations.

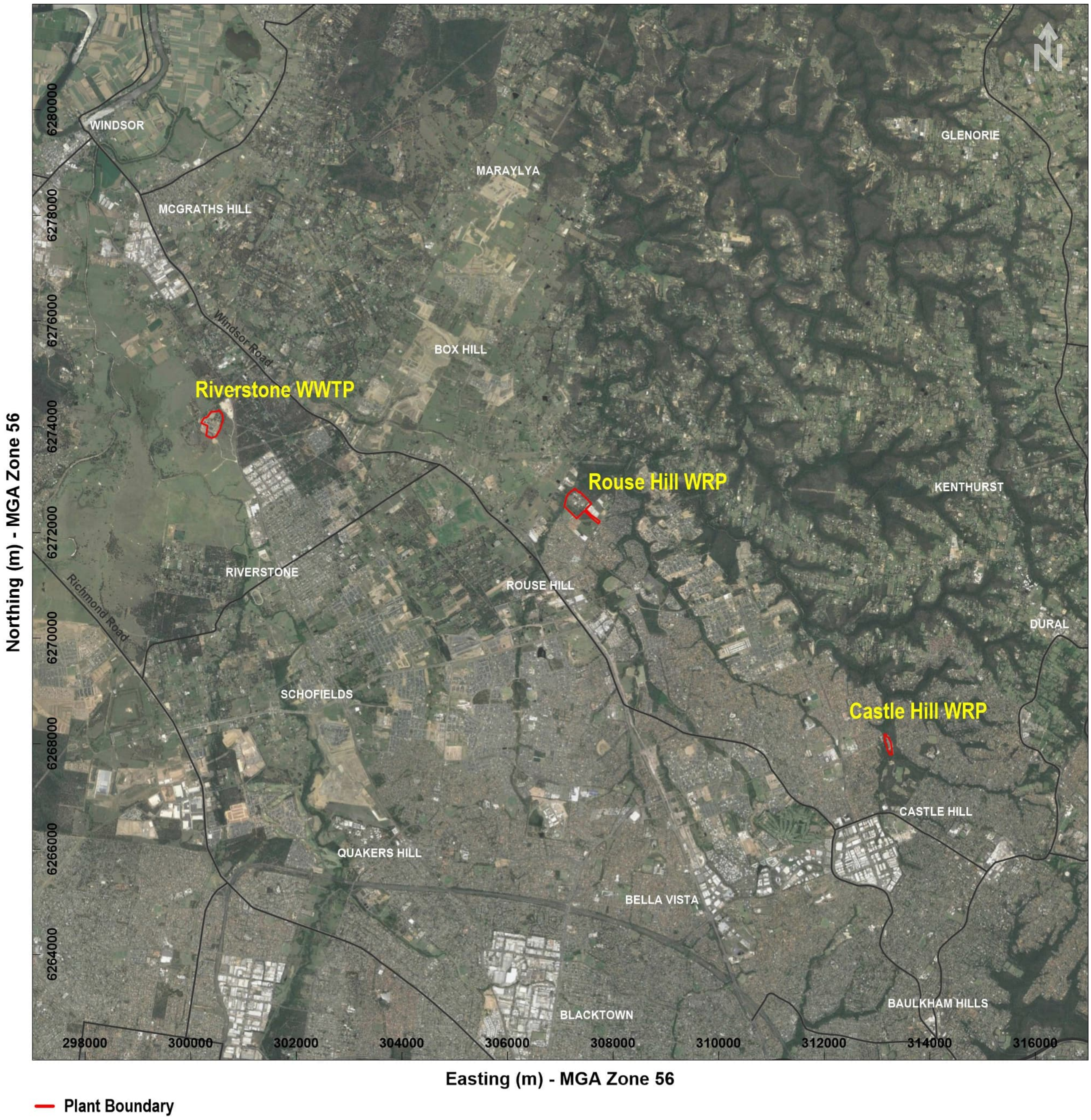

Figure 1 Overview of the North West Treatment Plant project

Forecasted growth in the catchments serviced by North West Treatment Hub will exceed treatment capacity. Rouse Hill WRP is currently operating in excess of its treatment capacity. Upgrades to the North West Treatment Hub are required to address growth in the catchment as well as meet future Environment Protection Licence (EPL) compliance limits to maintain waterway health.

‘Compliance upgrade’ works are being accelerated for delivery to enable the WRP to meet future EPL targets that will commence on 1 July 2024. Assessment of the odour impacts as a result of the compliance upgrade was provided in Jacobs (2021) (refer to Appendix A for a summary of results) to support an REF.

The proposed upgrades for the growth package at North West Treatment Hub are:

- new mechanical primaries (MPS) for dry weather.
- conversion of all existing IDALs to 4-stage-Bardenpho based membrane bioreactors (MBRs).
- new membrane tanks sized for 42.5 megalitres per day (ML/d) to be initially fitted out with membranes for 40.0 ML/d.
- upgrade process aeration blowers with additional blowers for process aeration and MBR air scour.
- new odour covers and odour extraction ducts for the new assets containing raw sewage and primary effluent, connected to the new odour control unit (OCU) from the compliance upgrade phase.
- decommission existing flow splitter structure and existing Stage 1 and Stage 2 inlet works.
- new ultraviolet (UV) train for the recycled water plant (RWP) and upgrade of existing trains UV.
- new ultrafiltration (UF) membranes.
- demolition of shallow bed filters and construction of new distribution chamber for the bypass CCTs.
- conversion of CCTs to create four (4) parallel bypass CCTs.
- decommission existing Stage 1 BNR plant.
- renewal of existing HV switchboard located in existing HV switch-room.
- HV network reticulation.
- new LV switch-rooms including new low voltage (LV) switchboards for all new Phase 2 loads.
- new transformer kiosks for the new LV switch-room loads.
- provision of emergency generator connection points at all new LV switchboards
- upgrade of Endeavour Energy supply connection including new high voltage (HV) switching station for the third incomer and network augmentation to suit the ultimate site power demand requirements.
- all electrical and control works, including HV and LV power distribution infrastructure, general power, control, and instrumentation requirements.
- PLC and SCADA upgrades to incorporate new treatment plant process units.
- decommission existing Stage 1 Tertiary Clarifier.
- the existing Stage 2 Tertiary Clarifier is also planned for decommissioning, however it is acknowledged that it may need to be retained should plant process proving suggest that the Stage 2 Tertiary Clarifier will be required for satisfactory filtration of MBR permeate through the DBMF.
- recycled water plant upgrade to meet ADD (12.8 ML/d) and MDD (35.3 ML/d).
- potable water and reclaimed effluent (RE) upgrade.
- sludge screening (for the sludge transfer pipeline system).
- new sludge transfer pipeline and pump station to Riverstone WWTP. This will be completed under a separate Reference Design package and Basis of Design.
- upgrade chemical storage and dosing facilities to incorporate new chemicals and new chemical demands, including a carbon dosing facility.
- decommission solids handling equipment.

Figure 2 shows the existing site layout, highlighting the key treatment processes and infrastructure. Rouse Hill WRP will continue to operate 24 hours per day, 7 days per week. A more detailed description of the Project is provided in the REF.

Figure 2 Site layout

3. Potential Air Quality Issues

Air quality issues can arise when emissions from an industry or activity lead to a deterioration in the ambient air quality. Potential air quality issues have been identified, considering the types of emissions to air and proximity of these emission sources to sensitive receptors.

Construction of the Project could lead to emissions to air from works associated with upgrading plant and equipment, though these works will be temporary. Construction-related emissions would mainly comprise of particulate matter in the form of:

- Total suspended particulates (TSP), typically where particles are less than 30 microns in equivalent aerodynamic diameter;
- Particulate matter with equivalent aerodynamic diameter of 10 microns or less (PM_{10}); and
- Particulate matter with equivalent aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

Odour emissions could vary during the construction phase due to works affecting existing sources of odour (e.g. cleaning, decommissioning) and establishing new sources of odour (e.g. commissioning). However, construction-related odour emissions are not considered to be significant as it is expected that works would be planned and executed in a way that does not cause an elevation in the emission of odours.

Operation of the Project will involve processes associated with the removal of contaminants from the incoming wastewater. Physical, chemical, and biological processes will be used to remove contaminants and produce treated water. There will be no biosolids processing on site.

Odour may be generated from the liquid and solid waste streams with a progressive reduction in odour intensity expected through the treatment process. Various odour treatment mechanisms will be in place to minimise emissions.

In summary, the potential air quality issues associated with the Project have been identified as:

- Dust (that is, particulate matter in the form of TSP, deposited dust, PM_{10} or $PM_{2.5}$) during construction; and
- Odour during operation.

These two issues are the focus of this assessment.

4. Air Quality Criteria

Air quality is typically quantified by the concentrations of air pollutants in the ambient air. Air pollution occurs when the concentration (or some other measure of intensity) of one or more substances known to cause health, nuisance and/or environmental effects, exceeds a certain level.

The Project has been assessed against the air quality criteria set by the EPA as part of its Approved Methods (EPA, 2016). Most of the EPA criteria are drawn from national standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environment Protection Measures (NEPMs) (NEPC, 1998). To measure compliance with ambient air quality criteria, the NSW Government has established a network of monitoring stations across NSW and up-to-date records are published on the Department of Planning, Industry and Environment (DPIE) air quality monitoring network website.

As noted in Section 3, the potentially most significant emissions to air from the Project will be:

- Dust (that is, particulate matter) during construction; and
- Odour during operation.

There are various classifications of particulate matter and the EPA has developed assessment criteria for TSP, PM_{10}, $PM_{2.5}$ and deposited dust. Table 1 shows the EPA air quality assessment criteria. The criteria for TSP and deposited dust have been set to protect against nuisance amenity impacts while the criteria for PM_{10} and $PM_{2.5}$ have been set to protect against health impacts.

Table 1 EPA air quality assessment criteria for particulate matter

Substance	Averaging time	Criterion
Particulate matter (as TSP)	Annual	90 µg/m^3
Particulate matter (as PM_{10})	24-hour	50 µg/m^3
	Annual	25 µg/m^3
Particulate matter (as $PM_{2.5}$)	24-hour	25 µg/m^3
	Annual	8 µg/m^3
Deposited dust	Annual (maximum increase)	2 g/m^2/month
	Annual (maximum total)	4 g/m^2/month

Odour assessment criteria are used to assess the potential for air emissions to impact on local amenity. The EPA has set odour assessment criteria as part of their Approved Methods (EPA, 2016) with more specific guidance outlined in the “Technical framework Assessment and management of odour from stationary sources in NSW” (DEC, 2006). The relevant odour assessment criteria are shown in Table 2.

Table 2 EPA air quality assessment criteria for odour

Population of affected community	Criterion (odour units) (nose response time average, 99th percentile)
Single rural residence (≤~2)	7
~10	6
~30	5
~125	4
~500	3
Urban (>2000) and/or schools and hospitals	2

The odour criteria are prescribed in odour units, not to be exceeded more than 1% of the time, for different population densities. The differences between odour criteria are based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For example, in a densely populated area there will be a greater risk that some individuals within the community will find an odour unacceptable than in a sparsely populated area.

The criteria assume that 7 odour units at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases there is more chance that sensitive individuals would be exposed. The criterion of 2 odour units at the 99th percentile is considered to be acceptable for the whole population. Dispersion models typically predict down to a 1-hour averaging time, so correction to “nose-response” averaging times (of the order of 1 second) is required. This correction is further explained in Section 6. The EPA odour criteria are based on “nose-response” averaging times.

The EPA criteria outlined above (that is, those in Table 1 and Table 2) apply to existing and potentially sensitive receptors, where the Approved Methods defines a sensitive receptor as *“a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area”*. This definition has also been interpreted as places of near-continuous occupation.

This assessment aims to identify the potential risk of dust and odour impacts (for example, complaints) through the application of the EPA assessment criteria. The criteria from the Approved Methods (EPA, 2016) are not compliance criteria.

The *Protection of the Environment Operations (POEO) Act 1997 (POEO Act)* was enacted on the 1st July 1999 and has an objective to ensure consistency by bringing the key pollution statutes under a single act. The *POEO Act* introduces the concept of “offensive odours” and there are provisions that specifically relate to odour. It provides that EPA licensed facilities “must not cause or permit the emission of any offensive odours from the premises”. Any licensed facility may be required to meet conditions designed to avoid or control odour. In addition, it is an offence for any person to cause air pollution (which includes dust and odour) due to poor maintenance of plant or the poor handling of material. For licensed facilities these requirements will be enforced by the EPA.

5. Existing Environment

This section provides a description of the environmental characteristics in the area, including a review of the local meteorological and ambient air quality conditions. One of the objectives for this review was to develop an understanding of any existing air quality issues as well as the meteorological conditions which typically influence the local air quality conditions.

5.1 Local Setting

Rouse Hill WRP is located in bushland off Mile End Road in a semi-rural, low density residential area. Nearest residential properties are located approximately 400 metres (m) of the southwest and southeast boundaries of the plant. Recreational fields are also located within 200 m of the southwest plant boundary. Permanent sensitive receptors are located in all directions from the plant but are nearest clockwise from the east-northeast to the southwest of the plant.

The Rouse Hill WRP is set at an elevation of approximately 40 m above sea level. The nearest receivers are set at an elevation of around 50 m. Terrain across the wider environment surrounding the plant is generally flat. Figure 3 shows a pseudo three-dimensional representation of the local terrain.

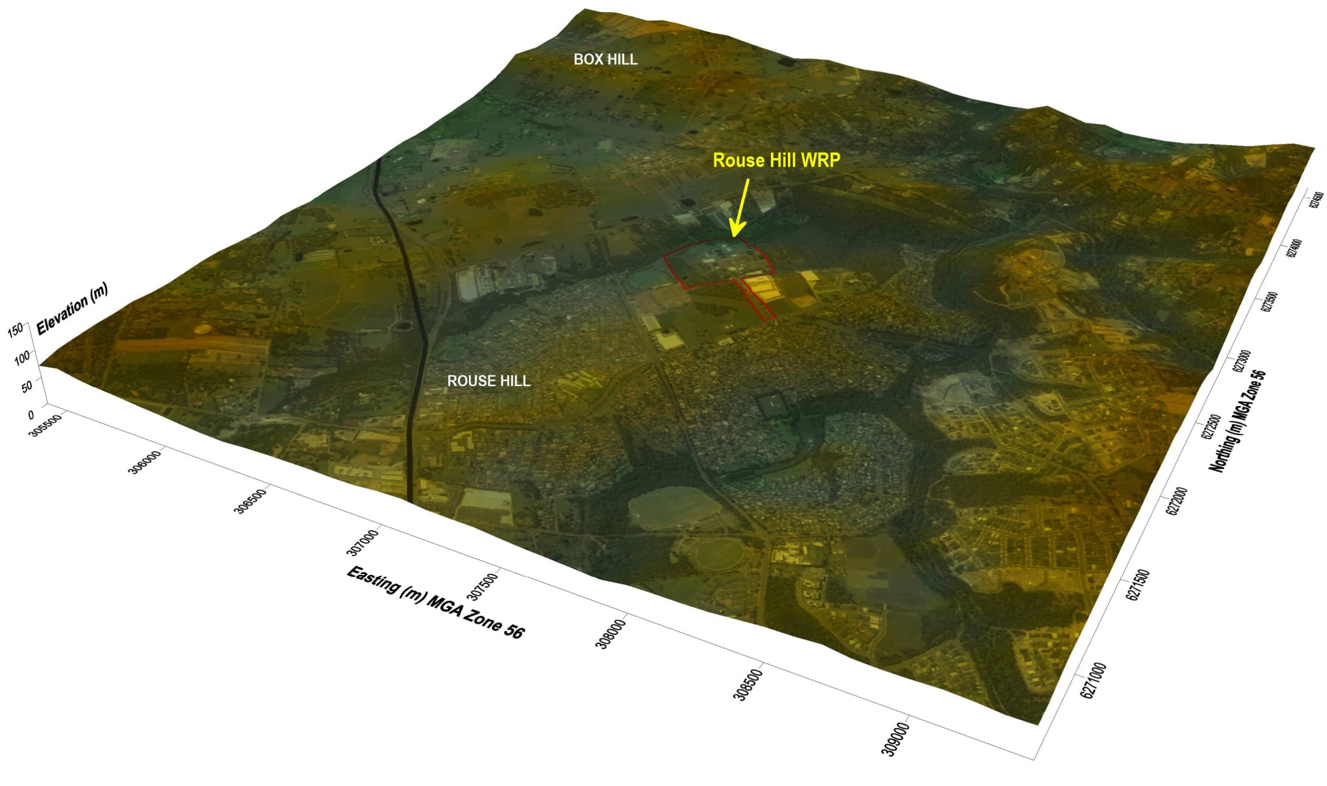

Figure 3 Pseudo three-dimensional representation of the local terrain

5.2 Meteorological Conditions

Meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The key meteorological requirements of air dispersion models are, typically, hourly records of wind speed, wind direction, temperature and atmospheric stability. For air quality assessments, a minimum of one year of hourly data is usually required, which means that almost all possible meteorological conditions, including seasonal variations, are considered in the model simulations.

The EPA has prescribed the minimum requirements for meteorological data that are to be used in dispersion modelling. These requirements are outlined in the Approved Methods (EPA, 2016) and state that at least one year of “site-specific” data should be used. If “site-specific” data are not available then “site-representative” data, correlated against at least five years of data, are acceptable. The meteorological data must also be at least 90 percent complete.

Meteorological monitoring is not carried out at the plant, however the DPIE commenced operation of a meteorological station at Rouse Hill, 2 km to the southwest of the plant, in mid-2019. Based on the topography and proximity of this station to the plant, this station would be classified as “site-representative” under the Approved Methods terminology. The DPIE also operates a meteorological station at Prospect, 15 km to the southwest of the plant.

Meteorological data from six recent years (2015 to 2020 inclusive and where available) from the two identified monitoring stations have been analysed to identify a representative year for the modelling. Hourly records of wind speed and wind direction were examined.

Figure 4 shows the annual and seasonal wind patterns based on data collected at Rouse Hill in 2020, the closest meteorological station to the site. It can be seen from these wind-roses that the most common winds in the area are from the north, southwest and southeast. This pattern of winds is evident in all seasons to some extent although winds in summer tend to be stronger than in other seasons.

At Prospect, the wind patterns from six years of data (Figure 5) exhibit similarities to those experienced in 2020 at Rouse Hill. However Rouse Hill appears to experience a slightly higher frequency of calm conditions, that is, 21 percent calms at Rouse Hill compared to 14 percent calms at Prospect. This is likely to be due to differences in the local land use noting that there is more bushland around the meteorological station at Rouse Hill than at Prospect.

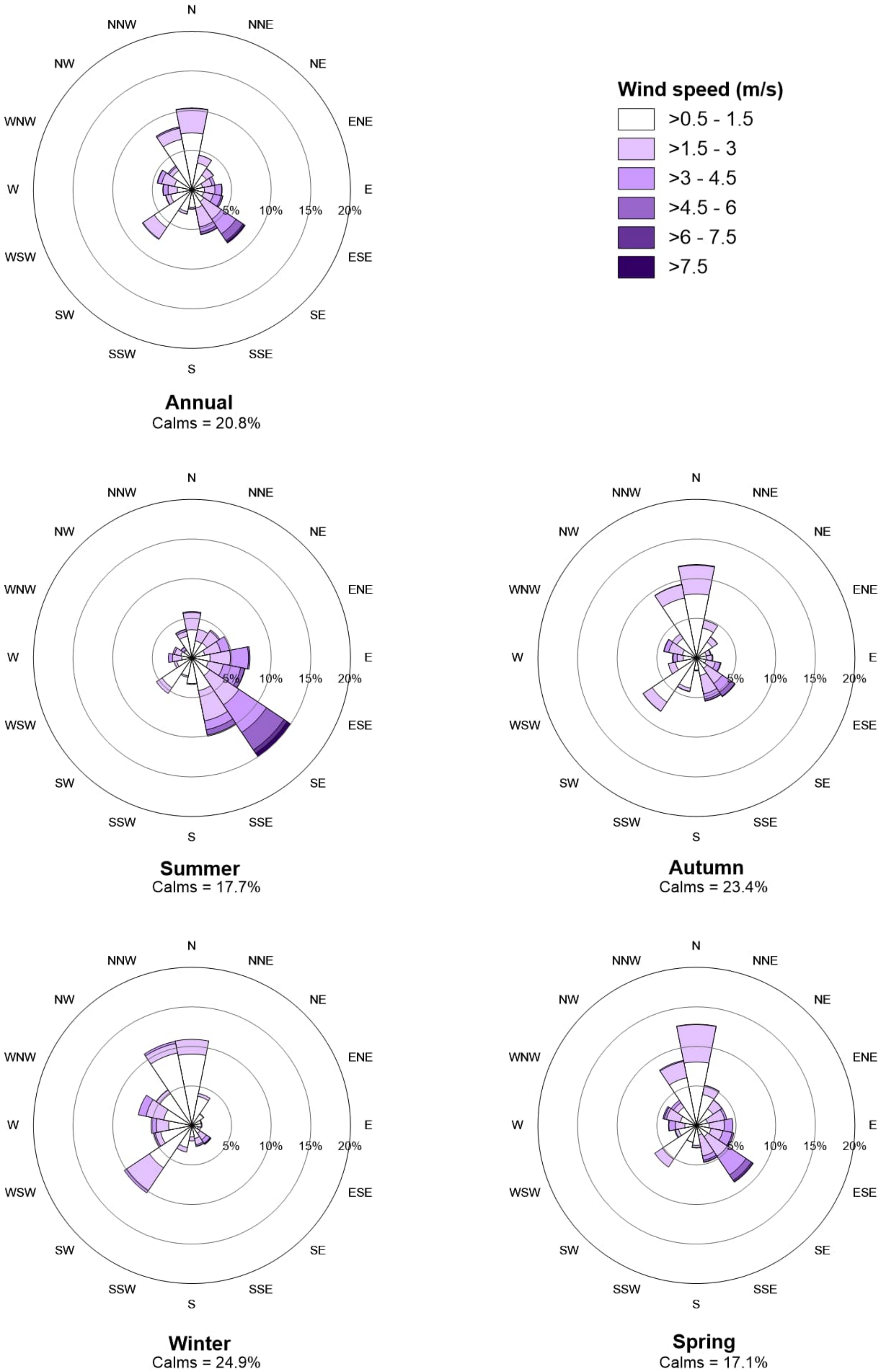

Figure 4 Annual wind-roses for data collected at the Rouse Hill meteorological station (2020)

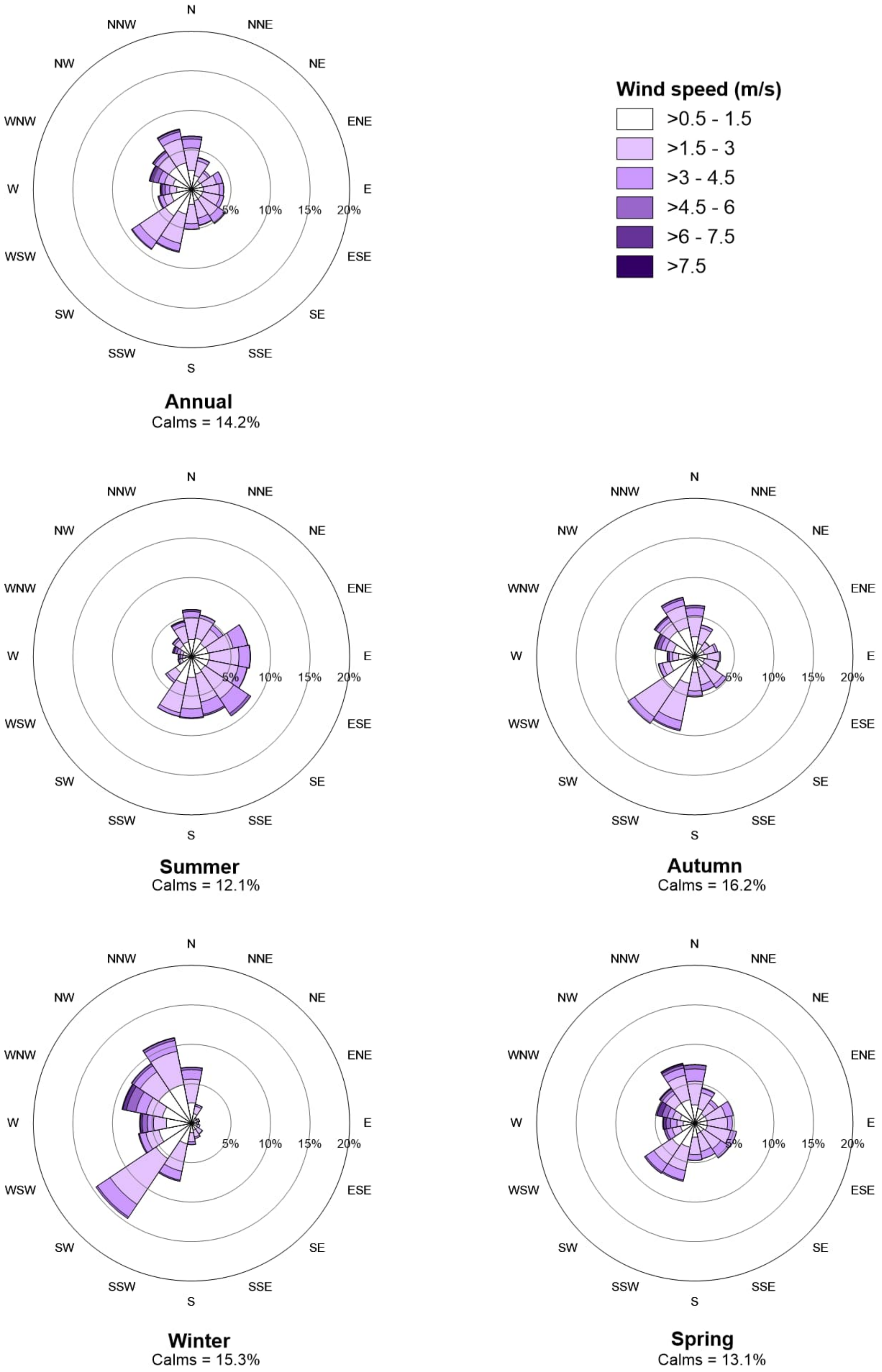

Figure 5 Annual wind-roses for data collected at the Prospect meteorological station (2015-2020)

Figure 6 shows the wind speed data from each meteorological station. As previously mentioned, the meteorological station at Rouse Hill was only installed in 2019. The data from Figure 6 show that, at Prospect, the average and maximum wind speeds exhibited similar ranges across all six years. Maximum wind speeds reached around 10 metres per second (m/s) as an hourly average and these winds were not isolated to any particular time of year. Similar data ranges were observed at Rouse Hill in 2019 and 2020.

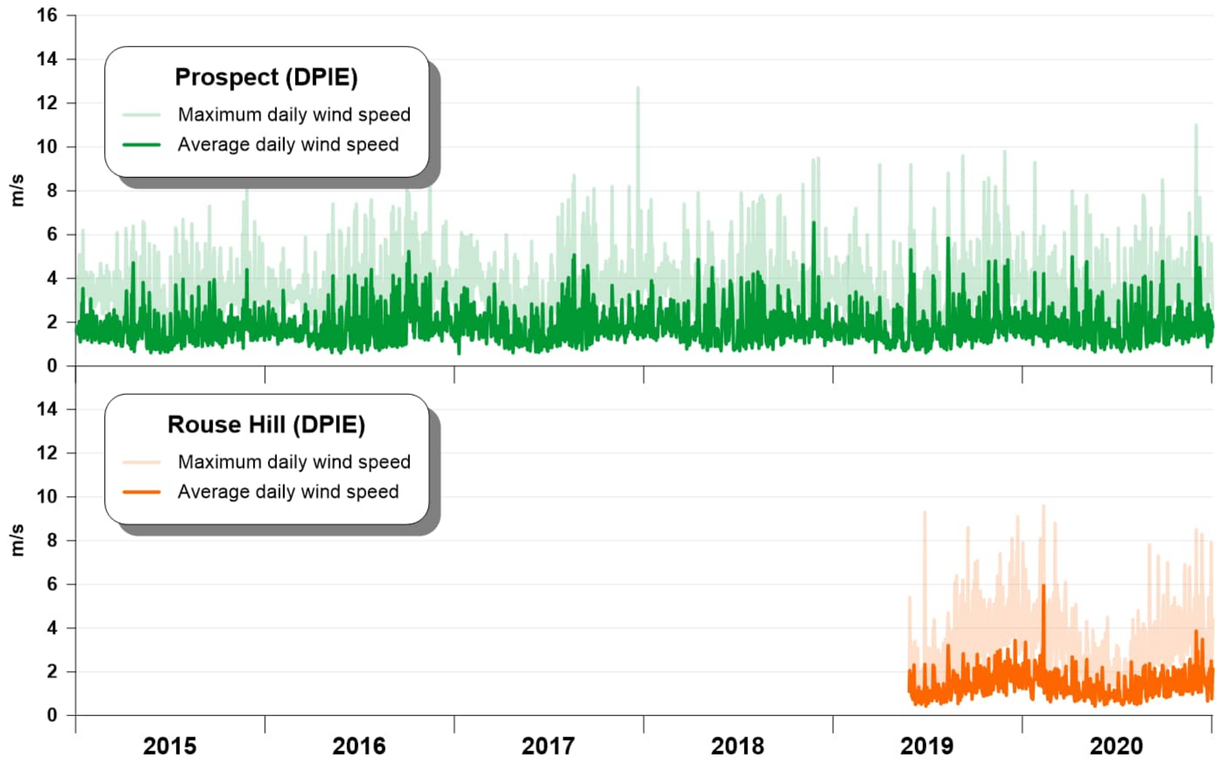

Figure 6 Wind speed data collected between 2015 and 2020

The annual data statistics for the 2015 to 2020 years have been examined to assist with identifying a representative meteorological year. Table 3 shows the statistics.

Table 3 Annual statistics from meteorological data collected between 2015 and 2020

Year	Rouse Hill	Prospect
Percentage complete (%)		
2015	NA	100
2016	NA	100
2017	NA	99
2018	NA	100
2019	60	99
2020	100	100
Mean wind speed (m/s)		
2015	NA	1.7
2016	NA	1.8
2017	NA	1.8
2018	NA	1.9
2019	1.4	1.8
2020	1.4	1.8

Year	Rouse Hill	Prospect
Percentage of calms (<= 0.5 m/s)		
2015	NA	14
2016	NA	14
2017	NA	14
2018	NA	13
2019	12.1	15
2020	20.8	14

Over these six years the mean annual wind speed at Prospect has shown very little range (1.7 to 1.9 m/s). The percentage of calms (that is, winds less than or equal to 0.5 m/s) has also been very consistent, ranging from 13 to 15 percent. The similar trends and statistics for each year suggest that meteorological conditions do not vary significantly from year-to-year.

For this air quality assessment, the data collected in 2020 from the Rouse Hill meteorological station have been used to inform the dispersion modelling. This selection was based on the proximity of the station to the area of interest, high data capture rate meeting the EPA’s requirement for a 90% complete dataset, and a slightly higher proportion of calm conditions that generally leads to higher, more conservative estimates of odour impacts from dispersion models. Methods used for incorporating the 2020 data into the meteorological modelling (CALMET) and air dispersion modelling for the plant (CALPUFF) are discussed in detail in Section 7.

5.3 Odour Complaints

Odour complaints data relating to the Rouse Hill WRP are shown in Figure 7 below. These data show that, historically, there has been up to 8 complaints in a one year period (2012/13) however there have not been any complaints in the past three years (i.e. from 2017/18 to 2019/20).

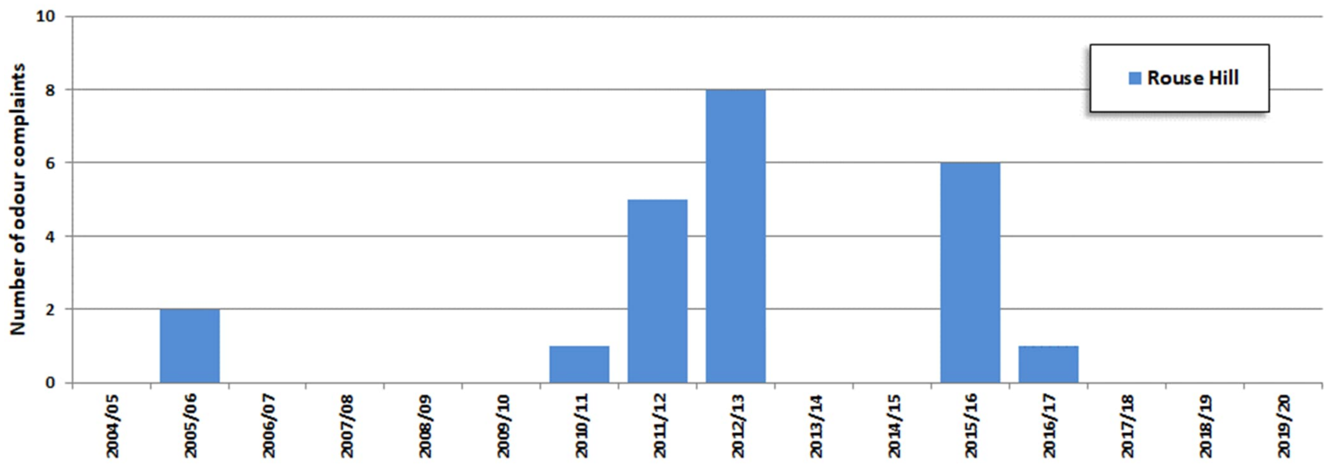

Figure 7 Registered odour complaints

6. Emissions to Air

Odours in domestic wastewater are caused by gases produced during the breakdown of organic matter. They are often the result of a mixture of volatile compounds, and over 100 compounds have been associated with odours at wastewater treatment plants.

Odour sensory methods, as opposed to analytical monitoring of individual compounds, are normally used to measure odours. Analytical monitoring of individual compounds is not usually practical, as odours are complex chemical mixtures. Odour sensory methods depend upon the olfactory response (sense of smell) of individuals who serve on evaluation panels.

Sensory response is measured using a dynamic olfactometer, which is a dilution device for the presentation of odours to a panel of observers. Using an olfactometer, a series of dilutions of an air sample from the odour source is presented to a panel of “sniffers”. The panel must indicate if there is a distinction between the sample and odour free air. The point at which only 50% of the panel can detect the smell is called the odour threshold. The number of times odorous air must be diluted with odour-free air in order for 50% of a selected panel of “sniffers” to detect a smell is related to the concentration of a particular odour, which is described in odour units. Hence 1 odour unit indicates that an equal volume of air is required to dilute a particular volume of odorous air to a level at which half the panel were able to detect the smell. This process, referred to as olfactometry, is used to quantify odour emissions from a particular source.

Sydney Water has developed an extensive database of odour emissions from all key wastewater treatment processes at almost all plants in their network. Emissions for modelling have been derived from historical site reviews and sampling programs and were measured using dynamic olfactometry according to the “Australian/New Zealand Standard: Stationary source emissions – Part 3: Determination of odour concentration by dynamic olfactometry (AS/NZS4323.3:2001)”.

The Sydney Water odour emissions database has been used to develop estimates of maximum emissions from the plant for baseline (i.e. existing plant) and upgrade scenarios. Table 4 and Table 5 show the source and emission data, as used by the dispersion model for the baseline and upgrade scenarios respectively. The main intent of the inventories is to capture the most significant emission sources that may influence off-site odour. Not every source will be captured. It is possible that there will be other sources of odour from time to time, such as leaks from covers and maintenance activities including cleaning. These potential sources are not expected to be significant enough to change odour impact outcomes but they will need to be managed and minimised during operations.

Conversion of the IDALs to MBRs is one of the main changes for the growth project and reductions in odour emissions are anticipated. However, the new OCU represents the potentially most significant odour source. It should be noted that a conservative approach has been taken for the upgrade modelling which assumes maximum odour concentrations from the OCU (500 ou). In reality the OCU will improve the characteristics of residual odour from the plant (i.e. less offensive). The OCU is also expected to improve the dispersion of emissions due to the discharge from an elevated point with vertical velocity.

Table 4 Estimated odour emissions for the baseline plant scenario

Source	Source type	Area (m^2)	Height (m)	Stack tip diam. (m)	Base elevation (m)	Temperature (K)	Velocity (m/s)	Air flow (m^3/s)	Odour conc (OU)	SOER ($ou.m^3/m^2/s$)	TOER ($ou.m^3/s$)
Existing OCU	Point	-	6.00	1.25	49	293	10.5	12.9	389	-	5032
Bioreactor	Area	2416	0.00	-	47	-	-	-	1009	0.39	942
Sludge Averaging Tank	Area	196	0.00	-	40	-	-	-	52	0.02	4
Aerobic digester	Area	1660	0.00	-	47	-	-	-	121	0.08	133
Selector	Area	260	0.00	-	49	-	-	-	1235	0.48	124
IDAL - aerating	Area	2138	0.00	-	46	-	-	-	789	0.30	652
IDAL - decanting	Area	948	0.00	-	48	-	-	-	287	0.11	105
IDAL - settling	Area	924	0.00	-	49	-	-	-	266	0.10	95
Catch Pond	Area	1300	0.00	-	43	-	-	-	294	0.11	140
Clarifier 1	Area	729	1.00	-	40	-	-	-	267	0.15	109
Clarifier 2	Area	729	1.00	-	41	-	-	-	267	0.15	109
Clarifier 3	Area	729	1.00	-	41	-	-	-	267	0.15	109
Dewatering Plant	Volume	-	3.00	-	39	-	-	0.321	2147	-	690
SP1139 OCU	Point	-	6.00	0.16	37	293	15.0	0.300	200	-	60
Sludge Balance Tank OCU	Point	-	3.00	0.29	39	293	15.0	0.975	250	-	244
										Total	8,458

Notes: SOER = Specific odour emission rate. TOER = Total odour emission rate.

Table 5 Estimated odour emissions for the upgrade plant scenario

Source	Source type	Area (m^2)	Height (m)	Stack tip diam. (m)	Base elevation (m)	Temperature (K)	Velocity (m/s)	Air flow (m^3/s)	Odour conc (OU)	SOER ($ou.m^3/m^2/s$)	TOER ($ou.m^3/s$)
SP1139 OCU	Point	-	6.00	0.16	37	293	15.0	0.300	200	-	60
Sludge Balance Tank OCU	Point	-	3.00	0.29	39	293	15.0	0.975	250	-	244
OCU	Point	-	15.00	1.00	47	293	14.1	11.11	500	-	5556
Membrane Tanks	Area	770	3.00	-	52	-	-	-	121	0.08	62
MBR (Bioreactor)	Area	4800	3.00	-	48	-	-	-	437	0.29	1392
Equalisation Basin	Area	1300	0.00	-	45	-	-	-	171	0.11	148
										Total	7,460

Notes: SOER = Specific odour emission rate. TOER = Total odour emission rate.

The odour emissions data have been multiplied by “peak-to-mean” factors to convert the model’s one hour averaging time to a nose-response averaging time, which is in the order of one second. Table 6 shows the peak-to-mean factors for each source based on the data prescribed by the EPA (2016).

Table 6 Peak-to-mean factors

Source	Peak-to-mean factors for each stability class					
	A	B	C	D	E	F
Existing OCU	2.3	2.3	2.3	2.3	2.3	2.3
Bioreactor	2.5	2.5	2.5	2.5	2.3	2.3
Sludge Averaging Tank	2.5	2.5	2.5	2.5	2.3	2.3
Aerobic digester	2.5	2.5	2.5	2.5	2.3	2.3
Selector	2.5	2.5	2.5	2.5	2.3	2.3
IDAL - aerating	2.5	2.5	2.5	2.5	2.3	2.3
IDAL - decanting	2.5	2.5	2.5	2.5	2.3	2.3
IDAL - settling	2.5	2.5	2.5	2.5	2.3	2.3
Catch Pond	2.5	2.5	2.5	2.5	2.3	2.3
Clarifier 1	2.5	2.5	2.5	2.5	2.3	2.3
Clarifier 2	2.5	2.5	2.5	2.5	2.3	2.3
Clarifier 3	2.5	2.5	2.5	2.5	2.3	2.3
Dewatering Plant	2.3	2.3	2.3	2.3	2.3	2.3
SP1139 OCU	2.3	2.3	2.3	2.3	2.3	2.3
Sludge Balance Tank OCU	2.3	2.3	2.3	2.3	2.3	2.3
OCU	2.3	2.3	2.3	2.3	2.3	2.3
Membrane Tanks	2.5	2.5	2.5	2.5	2.3	2.3
MBR (Bioreactor)	2.5	2.5	2.5	2.5	2.3	2.3
Equalisation Basin	2.5	2.5	2.5	2.5	2.3	2.3

7. Approach to Assessment

7.1 Overview

This assessment has followed the Approved Methods (EPA, 2016) which specifies how assessments based on the use of air dispersion models should be undertaken. The Approved Methods include guidelines for the preparation of meteorological data, reporting requirements and air quality assessment criteria to assess the significance of dispersion model predictions.

Potential impacts during construction have been assessed qualitatively by examining all proposed works and the proposed measures to manage emissions to air.

For operations, the CALPUFF computer-based air dispersion model has been used to simulate odour concentrations due to the identified emission sources, and the model results have been compared with relevant air quality criteria. The choice of model has considered the expected transport distances for the emissions, as well as the potential for temporally and spatially varying flow fields due to influences of the locally complex terrain, non-uniform land use, and potential for stagnation conditions characterised by calm or very low wind speeds with variable wind directions.

The CALPUFF model, through the CALMET meteorological pre-processor, simulates complex meteorological patterns that exist in a particular region. The effects of local topography and changes in land surface characteristics are accounted for by this model. The model comprises meteorological modelling as well as dispersion modelling, both of which are described below.

7.2 Meteorological Modelling

The air dispersion model used for this assessment, CALPUFF, requires information on the meteorological conditions in the modelled region. This information is typically generated by the meteorological pre-processor, CALMET, using surface observation data from local weather stations and upper air data from radiosondes or numerical models, such as the Commonwealth Scientific and Industrial Research Organisation's (CSIRO's) prognostic model known as TAPM (The Air Pollution Model). CALMET also requires information on the local land use and terrain. The result of a CALMET simulation is a year-long, three-dimensional output of meteorological conditions that can be used as input to the CALPUFF air dispersion model. The modelling therefore simulates dispersion under a comprehensive range of meteorological conditions including temperature inversions.

The closest known meteorological station that collects suitable upper air data for CALMET is located at Sydney Airport, approximately 30 km to the east of the plant. The necessary upper air data were therefore generated by TAPM, using influence from the surface observations at the Rouse Hill meteorological station. CALMET was then set up with one surface observation station and one upper air station (based on TAPM output for the location of the Rouse Hill surface meteorological station). The meteorological modelling followed the guidance of TRC (2011) and adopted the "observations" mode.

Key model settings for TAPM are shown below in Table 7.

Table 7 Model settings and inputs for TAPM

Parameter	Value(s)
Model version	4.0.5
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grids point	35 x 35 x 25
Year(s) of analysis	2020
Centre of analysis	Centre (33º41' S, 150º54' E)
Terrain data source	30 m Shuttle Research Topography Mission (SRTM)
Land use data source	Default
Meteorological data assimilation	Rouse Hill meteorological station. Radius of influence = 15 km. Number of vertical levels for assimilation = 4

Table 8 lists the model settings and input data for CALMET.

Table 8 Model settings and inputs for CALMET

Parameter	Value(s)
Model version	6.334
Terrain data source(s)	30 m SRTM
Land use data source(s)	Digitised from aerial imagery
Meteorological grid domain	20 km x 20 km
Meteorological grid resolution	0.2 km
Meteorological grid dimensions	100 x 100 x 9 grid points
Meteorological grid origin	297000 mE, 6262000 mN. MGA Zone 56
Surface meteorological stations	Rouse Hill: wind speed, wind direction, temperature and relative humidity (TAPM for ceiling height, cloud cover, and air pressure)
Upper air meteorological stations	Upper air data file for the location of the Rouse Hill meteorological station, derived by TAPM. Biased towards surface observations (-1, -0.8, -0.6, -0.4, -0.2, 0, 0, 0, 0)
Simulation length	8784 hours (1 Jan 2020 to 31 Dec 2020)
R1, R2	0.5, 1
RMAX1, RMAX2	5, 20
TERRAD	5

Terrain information was extracted from the NASA Shuttle Research Topography Mission database which has global coverage at approximately 30 m resolution. Higher resolution topographical data are not necessary in order to develop wind fields that reflect the influence of terrain and effects that are important for dispersion of emissions from the plant to the sensitive receptor areas. Land use data, for the definitions in CALMET, were extracted from aerial imagery. Figure 8 shows the model grid, land use and terrain information, as used by CALMET.

Figure 9 shows a snapshot of winds at 10 m above ground-level as simulated by the CALMET model under stable conditions.

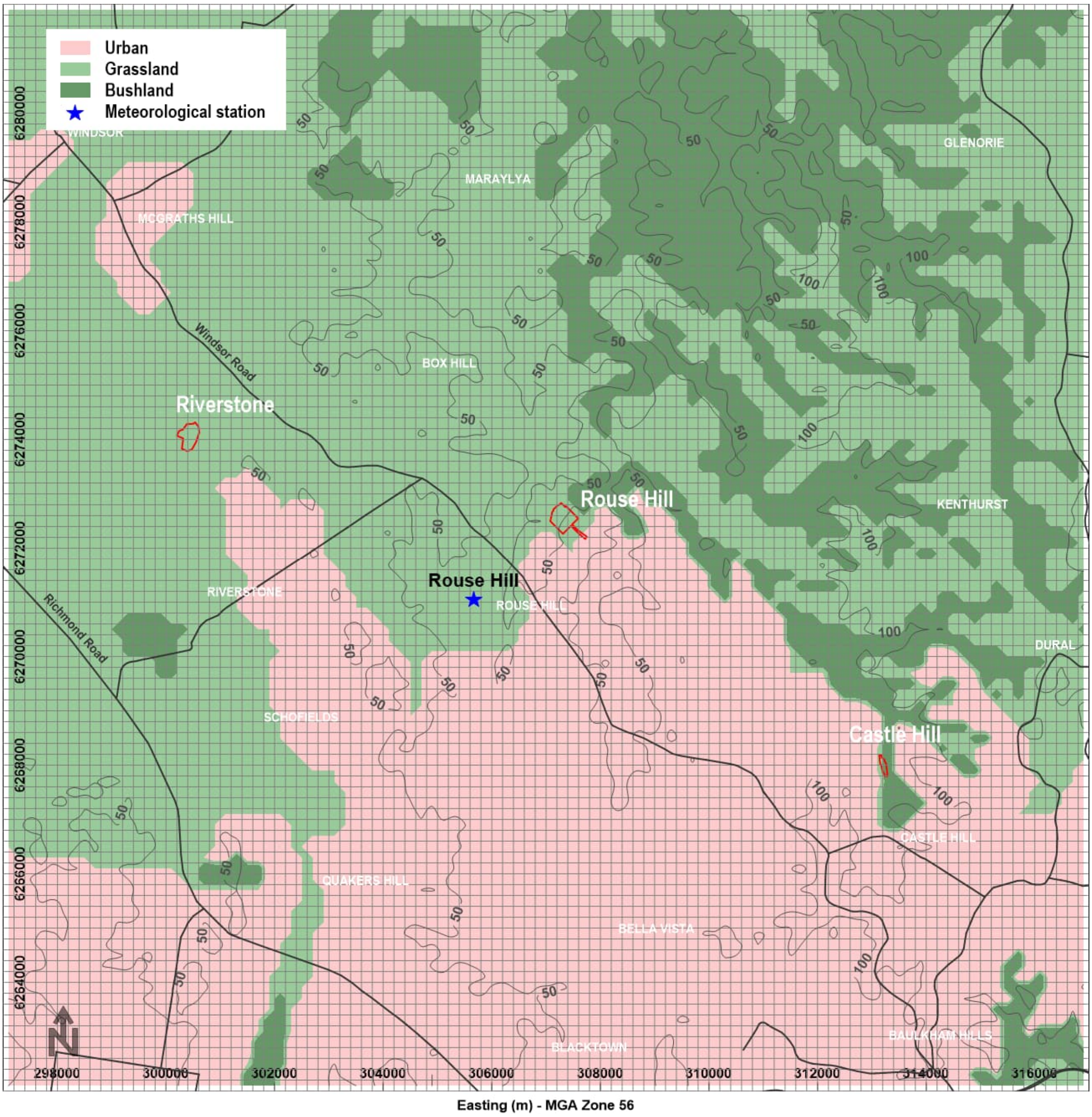

Figure 8 Model domain, grid, land use and terrain information

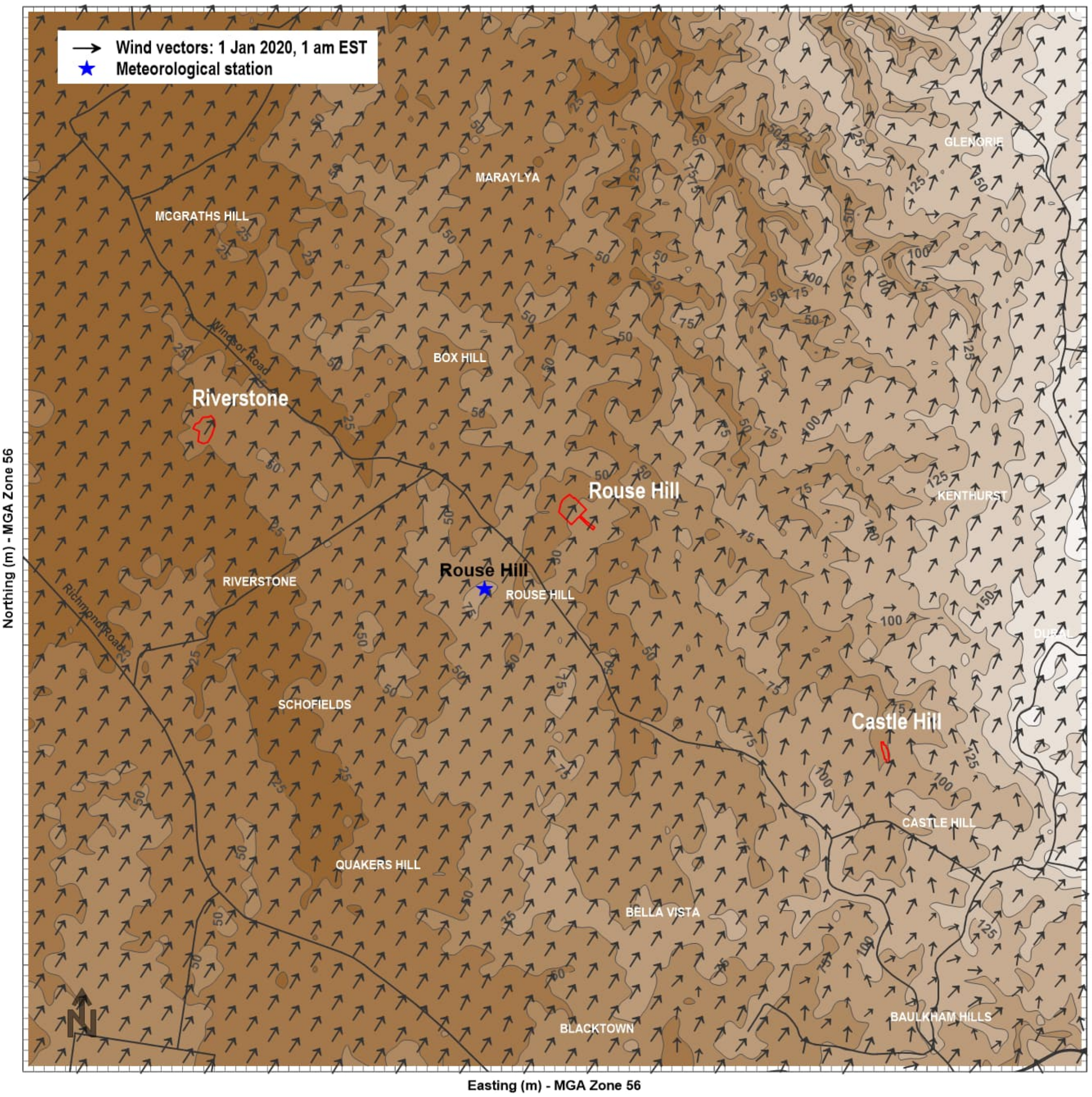

Figure 9 Example of CALMET simulated ground-level wind flows

7.3 Dispersion Modelling

Odour levels due to the identified emission sources at the plant have been modelled using CALPUFF (Version 6.42). CALPUFF is a Lagrangian air dispersion model that simulates the dispersion of pollutants within a turbulent atmosphere by representing emissions as a series of puffs emitted sequentially. Provided the rate at which the puffs are emitted is sufficiently rapid, the puffs overlap and the serial release is representative of a continuous release.

The CALPUFF model differs from traditional Gaussian plume models (such as AUSPLUME and ISCST3) in that it can model spatially varying wind and turbulence fields that are important in complex terrain, long-range transport and near calm conditions. CALPUFF has the ability to model the effect of emissions entrained into the thermal internal boundary layer that forms over land, both through fumigation and plume trapping. CALPUFF is an air dispersion model which has been approved by the EPA for these types of assessments (EPA, 2016).

The modelling was performed using the emission estimates from Section 6 and the meteorological information provided by the CALMET model, described in Section 7.2. Calculations were made at 1,017 discrete points (including sensitive receptors) to allow for contouring of results. The locations of the model receptors are shown in Appendix B.

Key model settings and inputs for CALPUFF are provided in Table 9.

Table 9 Model settings and inputs for CALPUFF

Parameter	Value(s)
Model version	6.42
CALMET model domain	Grid cells: Easting 1-100, Northing 1-100
CALPUFF computational domain	Grid cells: Easting 1-100, Northing 1-100
Dry deposition	No
Puff element	Puff
Dispersion option	Turbulence from micrometeorology
Time step	3600 seconds (1 hour)
Terrain adjustment	Partial plume path
Receptors	1017 discrete receptors. See Appendix B.

The plant was represented by a series of point, area and volume sources located according to the current and proposed site layouts. Figure 10 shows the modelled source locations. Emissions from all sources have been modelled at constant rates for every hour of the meteorological year.

Odour concentrations were modelled over an area of 4 km by 4 km and results at identified sensitive receptors were then compared with the EPA air quality criteria, previously discussed in Section 4. Contour plots have been created to show the spatial distribution of model predictions.

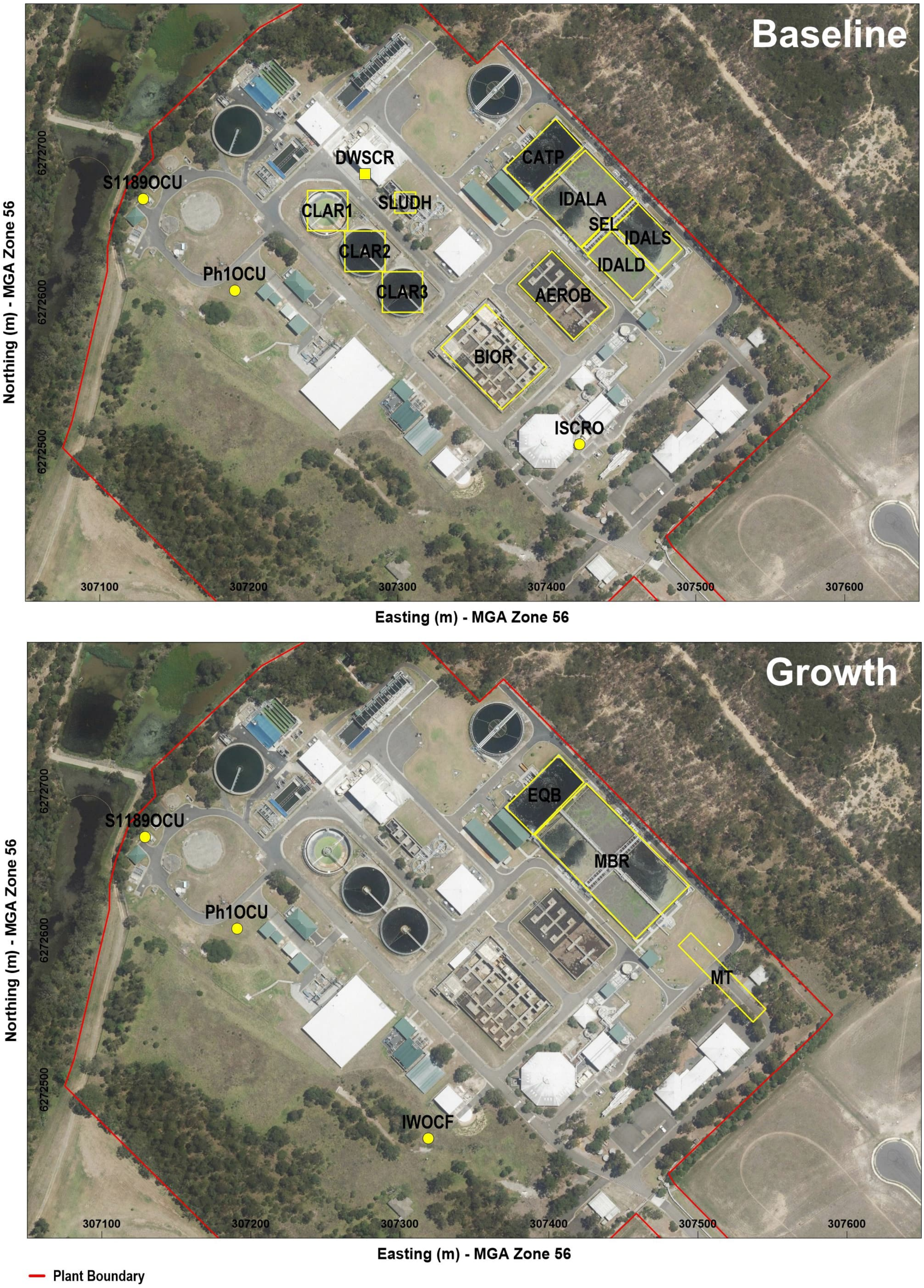

Figure 10 Modelled source locations

8. Air Quality Assessment

This section provides an assessment of the potential air quality issues of the Project, as identified in Section 3.

8.1 Construction

The key air quality issue during construction will be dust. Dust emissions from construction works have the potential to cause nuisance impacts, depending on the nature of works, and if not properly managed.

Construction of the upgrades is anticipated to take up to 2 years and will include:

- Site establishment such as installation of environmental controls, and plant and equipment delivery.
- Construction of new mechanical primaries, membrane tanks, odour covers, odour extraction ducts, odour control facility, ultraviolet train, ultrafiltration membranes and switch-rooms and transformer kiosks.
- Conversion of IDALs to MBRs.
- Upgrading energy networks, supply connections and chemical storage and dosing facilities.
- Decommissioning of clarifiers and solids handling equipment.
- Commissioning works such as equipment testing and discharging commissioning wastewater.

Construction would typically occur between 7 am to 6 pm Monday to Friday and between 8 am and 1 pm on Saturday. The number and type of equipment would vary depending on the development activity being undertaken. The total amount of dust generated would depend on the quantities and types of material being handled, the types of operations being carried out, exposed areas, speed of machinery, and emission control measures. The detailed approach to construction would depend on decisions made by the successful contractor(s), and changes to the construction methods and sequences that are expected to take place during the construction phase.

In practice, it is not possible to realistically quantify dust impacts using dispersion modelling in the construction phase. To do so would require knowledge of weather conditions for the period in which work would be taking place in each location on the site. The nature of the upgrades will require appropriate management measures to minimise the potential for off-site impacts.

Safeguards to minimise air quality impacts during construction will include:

- Maintaining equipment in good working order to comply with the clean air regulations of the *Protection of the Environment Operations Act 1997*, having appropriate exhaust pollution controls, and meeting Australian Standards for exhaust emissions.
- Switching off vehicles/machinery when not in use.
- Watering exposed areas using a non-potable water source, where possible.
- Covering exposed areas with tarpaulins or geotextile fabric, where possible.
- Modifying or ceasing work in windy conditions.
- Covering all transported waste.

Odour impacts are not considered to be a major issue during construction. There is existing odour control equipment on site and odour management strategies in place, which would be used to continue to control odours during construction. It is expected that any works that could increase odour emissions (e.g. cut-over to new OCU) would be planned and executed such that the magnitude and duration of elevated off-site odour impacts is minimised.

Safeguards to manage the risk of odour impacts during construction will include:

- Works will be subject to odour complaints management in line with Sydney Water's customer complaint procedure (e.g. receipt of complaints will result in adjustment of how and when works are carried out).
- Works will be carried out according to prevailing weather conditions (e.g. do not undertake cleaning of infrastructure during calm conditions with low wind speeds or winds directed towards receptors).
- Timing of works to avoid sensitive periods (e.g. avoid doing works with additional odour risk in the evening or weekends).
- Minimising the exposure of odour emitting surfaces (e.g. skip bins containing odorous debris) and minimising openings of odour emitting processes (e.g. tanks) created during construction phase with covers.
- Temporarily augmenting the operation of existing odour control systems to mitigate works with additional odour risk (e.g. use OCU to draw more air from process units with open covers, increase chemical dosing etc).

8.2 Operation

The potential odour impacts of the plant have been quantified using dispersion modelling. Figure 11 shows the modelled odour levels (in odour units) at the 99th percentile due to all identified sources in the baseline and growth upgrade scenarios. The results have been assessed by referencing the EPA odour impact assessment criteria from Section 4. As noted in Table 2 the EPA criteria are population based, that is, more stringent criteria are to be applied for higher population densities. The appropriate assessment criterion has been determined by examining the likely population within the 2 ou contour and applying the EPA criterion that corresponds to that population (from Table 2).

Figure 11 shows that the 2 ou contours do not encroach on any private sensitive receptors or residential areas in either the baseline or upgrade scenarios. However the 2 ou contours do extend into workplaces and commercial developments along Money Close, adjacent to the southeast boundary of the plant. It is been estimated that the occupancy of these developments will be no more than 125 people at any one time and therefore, from Table 2, the corresponding assessment criterion to be applied for this population is 4 ou. The 4 ou contour extends approximately 50 m outside the plant boundary and is not considered to represent an impact to the adjacent workplaces.

The modelling suggests that the growth upgrade scenario will likely reduce off-site odour impacts and it can be inferred that the proposed upgrades are unlikely to increase the intensity or frequency of off-site odour levels. As noted in Section 6, the modelling represents a conservative estimate of impacts given that maximum odour concentrations from the OCU (500 ou) have been assumed. In reality the proposed works are anticipated to improve the characteristics of residual odour from the plant (i.e. less offensive), reduce overall emissions and reduce off-site impacts. From this outcome it can be inferred that the plant is unlikely to cause "offensive odours" as per the provisions of the POEO Act.

To make sure that the odour footprint of the upgraded plant is minimised it is anticipated that Sydney Water will:

- Continue the practice of odour complaints management in accordance with Sydney Water's customer complaint procedure.
- Update the site's odour control procedure with the additional odour sources (i.e. new OCU).

Should there be sufficient drivers, Sydney Water may wish to revise the site's odour footprint once construction works are complete and the new odour sources have been sampled to determine their odour emission rates.

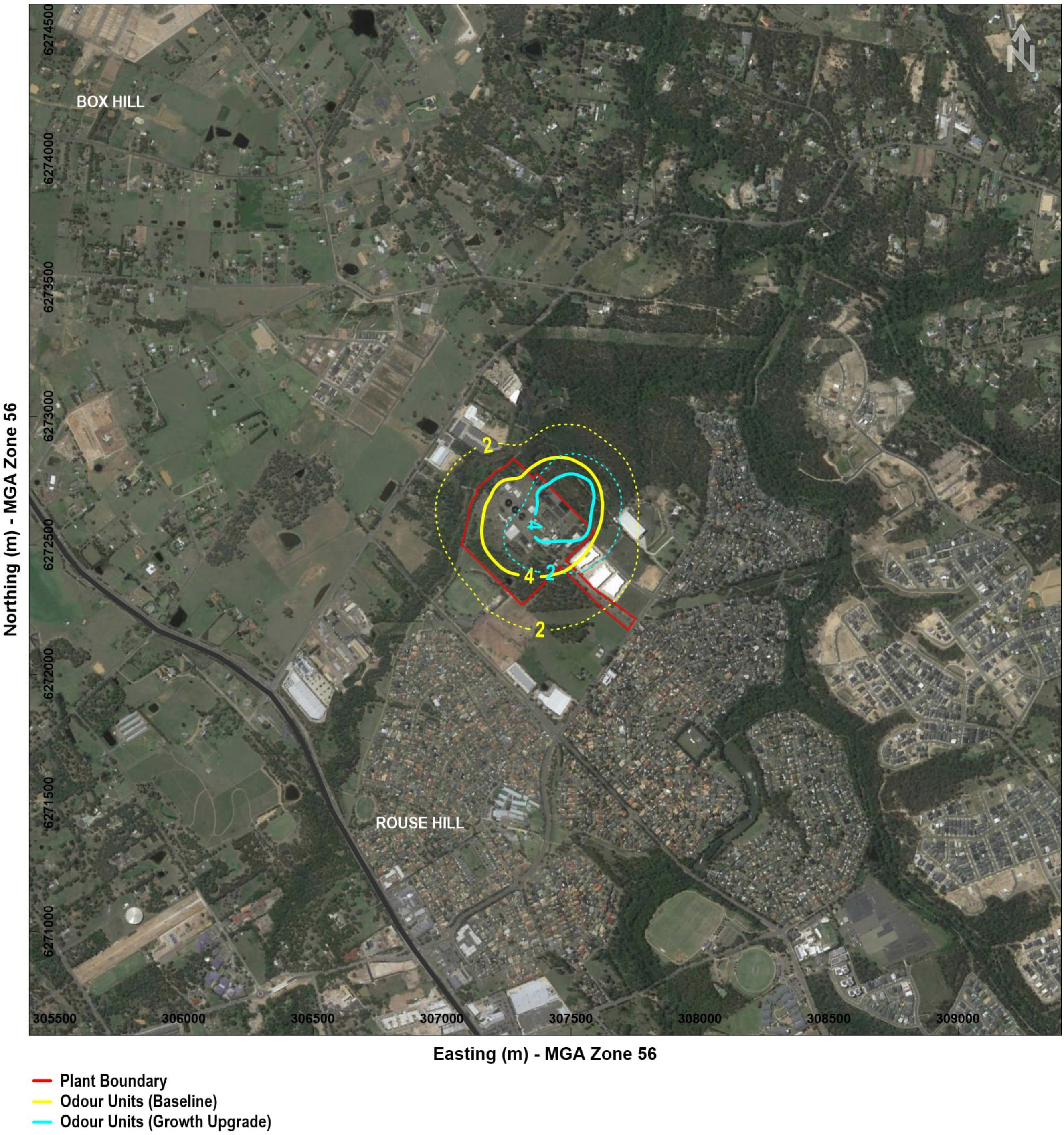

Figure 11 Modelled odour levels at the 99th percentile due to Rouse Hill WRP

9. Conclusions

This report has assessed the potential air quality impacts of proposed upgrades to the Rouse Hill WRP. In summary, the assessment identified the key air quality issues, characterised the existing air quality and meteorological environment, quantified project emissions and used an air dispersion model to simulate the potential impact of the Project on local air quality.

The key potential air quality issues were identified as:

- Dust during construction; and
- Odour during operation.

A detailed review of the existing environment was carried out and the following conclusions were made:

- The prevailing winds in the area are from the north, southwest and southeast.
- There have been historical complaints relating to odour however the operation of the existing plant has not caused adverse odour impacts in the local community in the past three years.

The main conclusions of the assessment were as follows:

- Dust from construction was determined to have limited potential to cause adverse impacts based on the nature, scale and duration of the proposed works. Nevertheless, appropriate environmental safeguards have been identified to minimise impacts.
- The proposed upgrades are unlikely to cause adverse odour impacts during operation based on conservative modelling which showed compliance with the most stringent EPA assessment criteria at the nearest existing and potential private sensitive receptors and residential areas. In addition, the proposed upgrades will likely reduce the intensity and frequency of off-site odour levels relative to existing operations.

Finally, it was noted that emissions from many of the key odour generating sources will be ducted to the proposed odour control facility, treated and exhausted via a stack. This arrangement is consistent with best practice for odour management at wastewater treatment plants.

10. References

DEC (2006) "Technical framework Assessment and management of odour from stationary sources in NSW". Published by the Department of Environment and Conservation, now EPA. November 2006.

EPA (2016) "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW".

Jacobs (2021) "North West Treatment Hub (Rouse Hill) – Air Quality Impact Assessment". Final, Revision 0. Dated 10 August 2021. Compliance upgrade works.

NEPC (1998) "Ambient Air – National Environment Protection Measure for Ambient Air Quality", National Environment Protection Council, Canberra.

TRC (2007) CALPUFF model web-site (http://www.src.com/calpuff/regstat.htm).

TRC (2011) "Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW'". Prepared for the Office of Environment and Heritage by TRC, March 2011.

Appendix A. Model results for compliance upgrades

Figure A1 Modelled odour levels at the 99th percentile due to Rouse Hill WRP compliance upgrades

Note. The baseline model for the compliance upgrade was completed in 2021. The baseline model for the Growth project was updated in 2022 to reflect a more accurate representation of the existing plant.

Appendix B. Model receptors

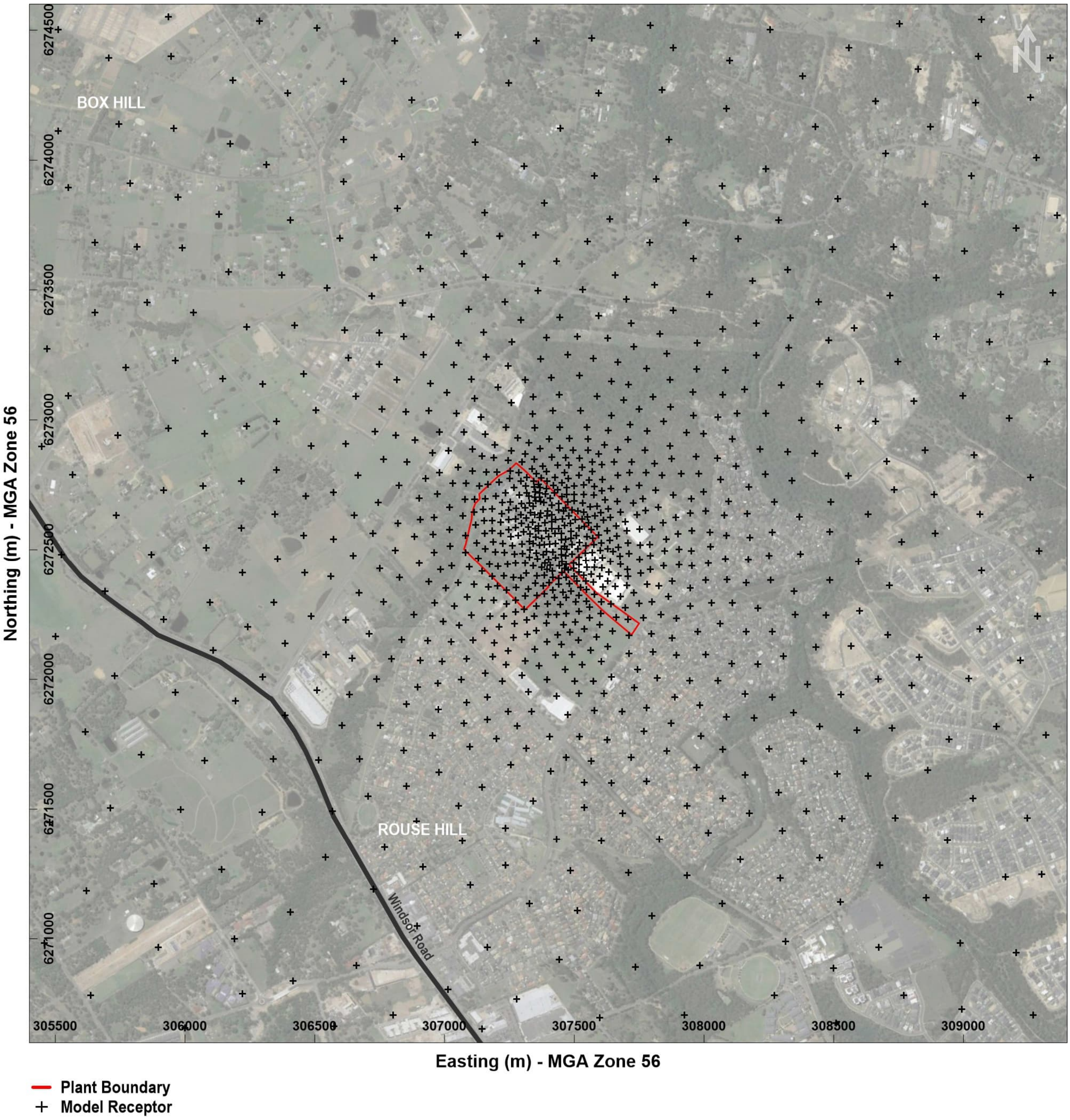

Figure B1 Model receptors