REGIONAL JOB PRECINCT

AIR, NOISE AND ODOUR TECHNICAL REPORT – SOUTH JERRABOMBERRA

Regional NSW

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Regional Job Precinct
Air, Noise and Odour Technical Report
South Jerrabomberra

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GLOSSARY

Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background levels	Existing concentration of pollutants in the ambient air.
Background noise	The underlying level of noise present in ambient noise, generally excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{AF90} descriptor.
CALPUFF	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.
Decibel (dB)	A measure of sound level. The decibel is a logarithmic way of describing a ratio. The ratio may be power, sound pressure, voltage, intensity or other parameters. In the case of sound pressure, it is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure squared to a reference sound pressure squared.
Diffuse source	Activities that are generally dominated by fugitive area or volume-source emissions, which can be relatively difficult to control.
Dispersion modelling	Modelling by computer to mathematically simulate the effect on plume dispersion under varying atmospheric conditions; used to calculate spatial and temporal fields of concentrations and particle deposition due to emissions from various source types.
EPL	Environmental protection licence
H_2S	Hydrogen sulfide
Incremental impact	The impact due to an emission source (or group of sources) in isolation, i.e. without including background levels.
µg	Mass in micrograms.
m^3	Volume in cubic metres.
NO_2	Nitrogen dioxide.
NO_x	Oxides of nitrogen, including NO and NO_2.
PM_{10}	Particulate matter less than 10 µm in aerodynamic equivalent diameter.
$PM_{2.5}$	Particulate matter less than 2.5 µm in aerodynamic equivalent diameter.

Point source	Source of emissions, generally a stack. Emissions can generally be relatively easily controlled by using waste reduction, waste minimisation and cleaner production principles or conventional emission control equipment
Sensitive receptor	A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area.
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
Stack	A vertical pipe used to vent pollutants from a process
O_3	Ozone
VOCs	Volatile organic compounds

1 INTRODUCTION

Todoroski Air Sciences has prepared this air, noise and odour technical report for the Department of Regional NSW (DRNSW). The report presents an analysis of the air, noise and odour impacts associated with the Master Plan developed for the South Jerrabomberra Regional Job Precinct (RJP) area located near Queanbeyan, New South Wales (NSW).

This technical report incorporates the following aspects:

- A summary of the baseline air, noise and odour conditions for the RJP;
- An outline of the methodology proposed to assess air, noise and odour matters associated with the Master Plan of the RJP;
- Presentation of the predicted results for the analysis of the Master Plan for the RJP; and,
- A discussion on the key findings and the mitigation and management strategies for the RJP with regard to the air, noise and odour impacts.

1.1 Overview

The RJPs are an extension of the Special Activation Precinct (SAP) program, focused on providing planning support to help fast-track approvals to drive growth, investment and development opportunities within regional NSW.

To assist with the strategic planning of the RJPs an air, noise and odour study is required to determine the appropriate planning response in relation to air, noise and odour emission from industry and development within the RJP investigation area to limit land use conflict.

The purpose of this technical report is to present the findings for environmental air, noise and odour matters for the South Jerrabomberra RJP Master Plan to inform development standards and precinct-based planning controls to address air, noise and odour concerns.

1.2 Relevant legislation

Air Quality (including odour) and Noise are regulated in NSW under the *Protection of the Environment Operations Act 1997* and subordinate regulations made under the Act. These are the Protection of the Environment Operations (Clean Air) Regulation 2021 and the Protection of the Environment (Noise Control) Regulation 2017.

The Regulation enables the appropriate regulatory authority (the NSW Environment Protection Authority [EPA]) to develop guidelines and policies for managing air quality and odour. The key guidelines applicable for the RJP investigation area include the following:

- Approved Methods for the Modelling and Assessment of Air Quality in New South Wales (2016) (Approved Methods);
- NSW Odour Policy, comprised of:
    - Technical Framework – Assessment and Management of odour from stationary sources in NSW (2006a); and,

    - Technical Notes – Assessment and Management of odour from stationary sources in NSW (2006b).

- Noise Policy for Industry (2017) (NPfI).

These guidelines set out suitable criteria for air pollutants, odour and noise to prevent adverse impacts on amenity and health for sensitive receptors such as residential areas. In addition to the above, other relevant policies and guidelines include:

- National Environment Protection Measure (NEPM) Ambient Air Quality (National Environment Protection Council, 2021)
- NSW Road Noise Policy (DECCW, 2011);
- Rail Infrastructure Guideline (EPA, 2013);
- Interim Construction Noise Guideline (NSW DECC, 2009); and,
- Assessing Vibration: A Technical Guideline (DEC, 2006).

1.3 Local setting

The South Jerrabomberra RJP investigation area covers approximately 950 hectares (ha) and encompasses the Poplars Innovation Precinct, North Poplars Retail Precinct, the South Tralee residential estate and new high school and regional sport complex. The RJP investigation area borders the Hume Industrial Precinct and NSW / Australian Capital Territory (ACT) border to the west and the suburb of Jerrabomberra to the east. **Figure 1-1** presents the South Jerrabomberra RJP investigation area.

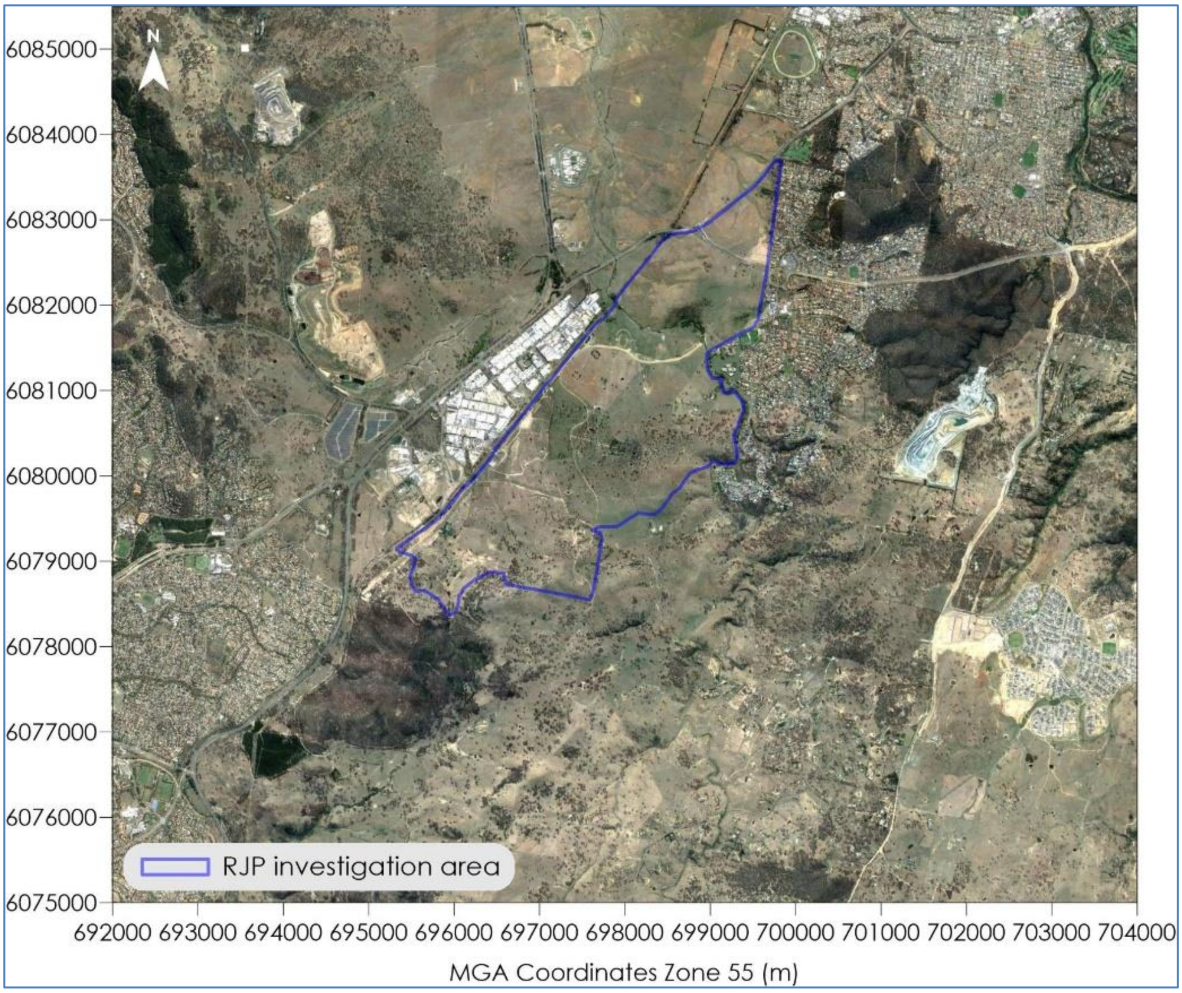

Figure 1-1: Local setting

1.4 Local topography

Figure 1-2 and **Figure 1-3** presents a representative three-dimensional visualisation of the terrain features surrounding the South Jerrabomberra RJP.

The topography of most of the RJP investigation area has a relatively gentle slope downwards towards the north and northwest with increasing elevation near the southern boundary and the northern eastern tip. Outside of the RJP investigation area, there are elevated ridges to the south and the east with relatively flat terrain to the north and immediate west. To the west is an existing industrial area in flat terrain just over the ACT border.

The terrain features of the surrounding area influence the local wind distribution patterns and flows which are important for the dispersion and propagation of air, noise and odour emissions.

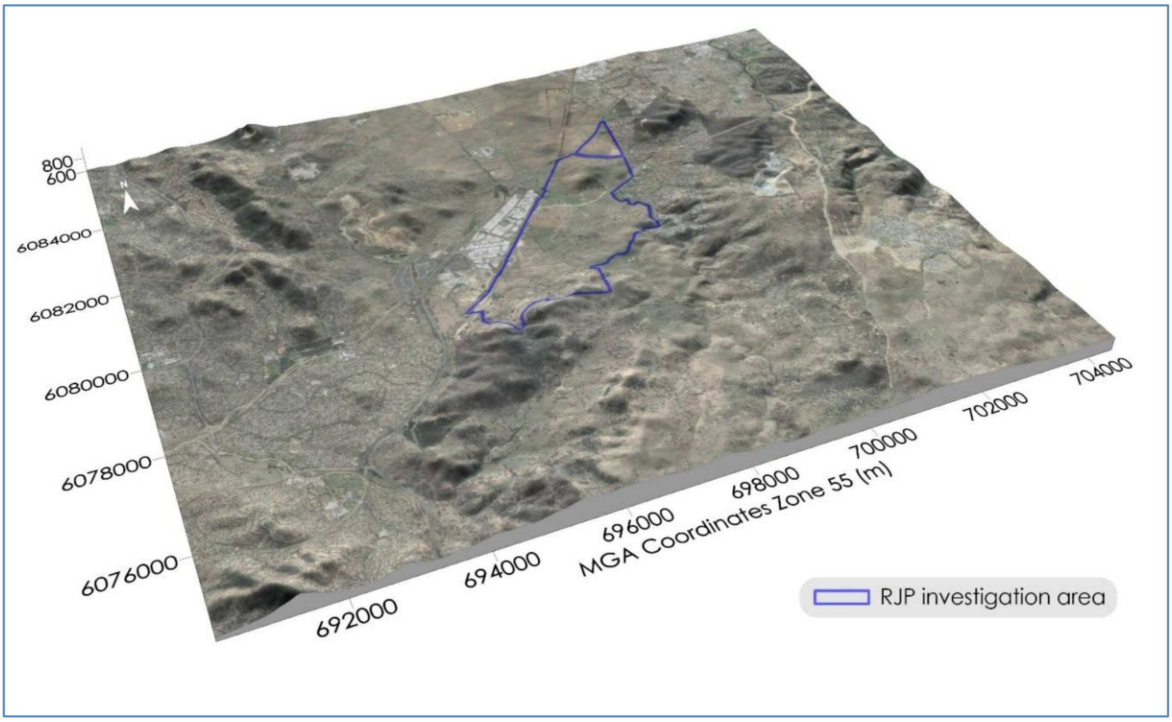

Figure 1-2: Representative visualisation of local topography surrounding the South Jerrabomberra RJP investigation area

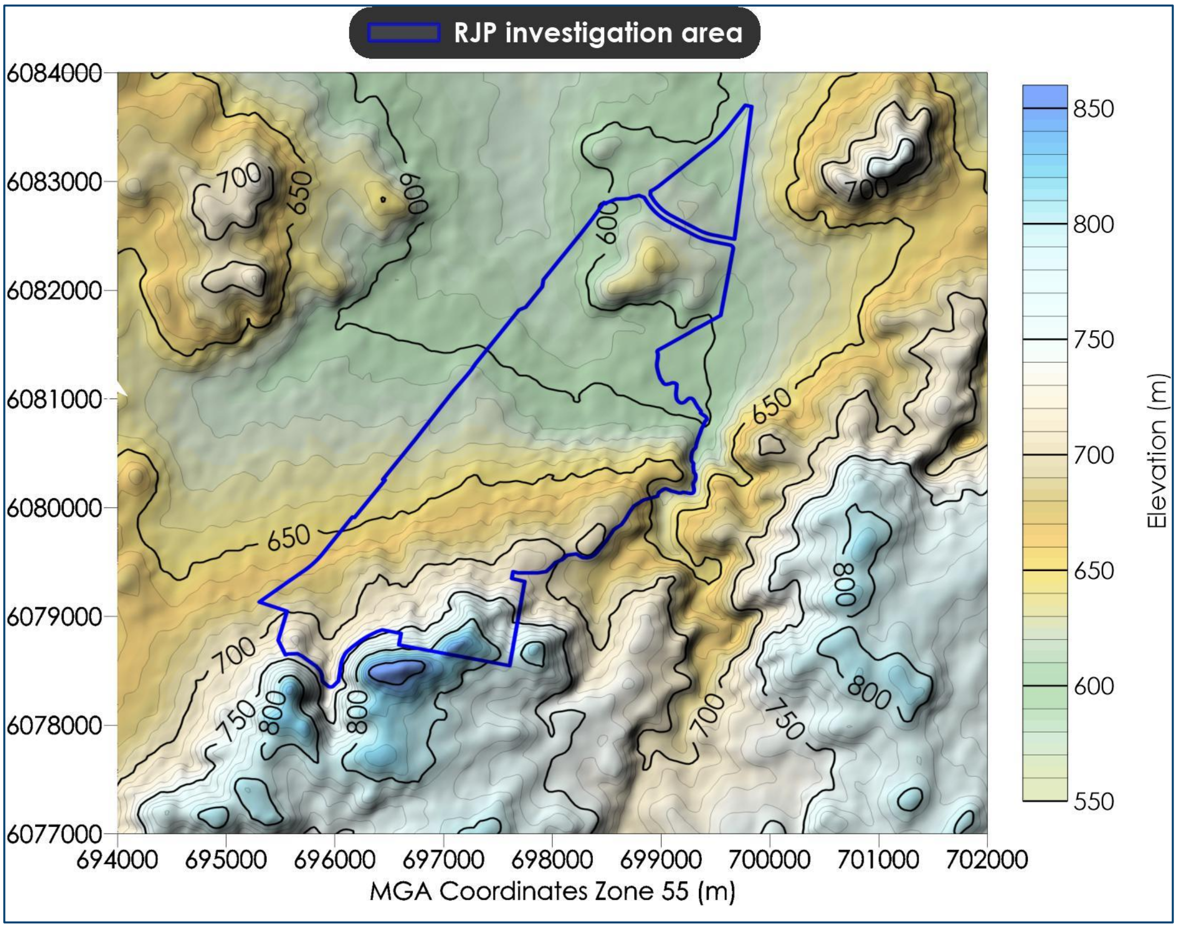

Figure 1-3: Local topography of the South Jerrabomberra RJP investigation area

1.5 South Jerrabomberra RJP Vision

The South Jerrabomberra RJP vision statement was developed in consultation with Queanbeyan-Palerang Regional Council, Department of Regional NSW (DRNSW), Department of Planning and Environment (DPE), Environment Protection Authority (EPA), Transport for New South Wales (TfNSW), Essential Energy and the consultant project group during stakeholder workshops as part of the master planning process. Technical information on air and noise matters specific to this locality was provided by Todoroski Air Sciences during the master planning process, helping the team accommodate such considerations in the precinct design.

South Jerrabomberra Regional Job Precinct will be the capital region's most attractive new location for tech-businesses to grow and prosper, in a well-designed, well-connected and well-supported place. A vision and six principles have been developed to guide the Master Plan outcomes:

- Innovative tech-jobs precinct
- Seamless precinct and cross border connectivity
- High quality urban design and placemaking
- Leading sustainability outcomes
- Be a good neighbour
- Collaborative cluster

1.6 South Jerrabomberra RJP Master Plan

The draft South Jerrabomberra RJP Master Plan, developed by Jensen Plus, is shown in **Figure 1-4**. Key features of the draft Master Plan include:

- Areas for industry and business park predominantly in the eastern portion of the RJP;
- Provision of conservation zones and rural areas covering a wide portion of the RJP;
- Identification of residential areas toward the southern portion of the RJP; and,
- Other features including space, defence and technology sector in the central portion of the RJP, and education and activity centres.

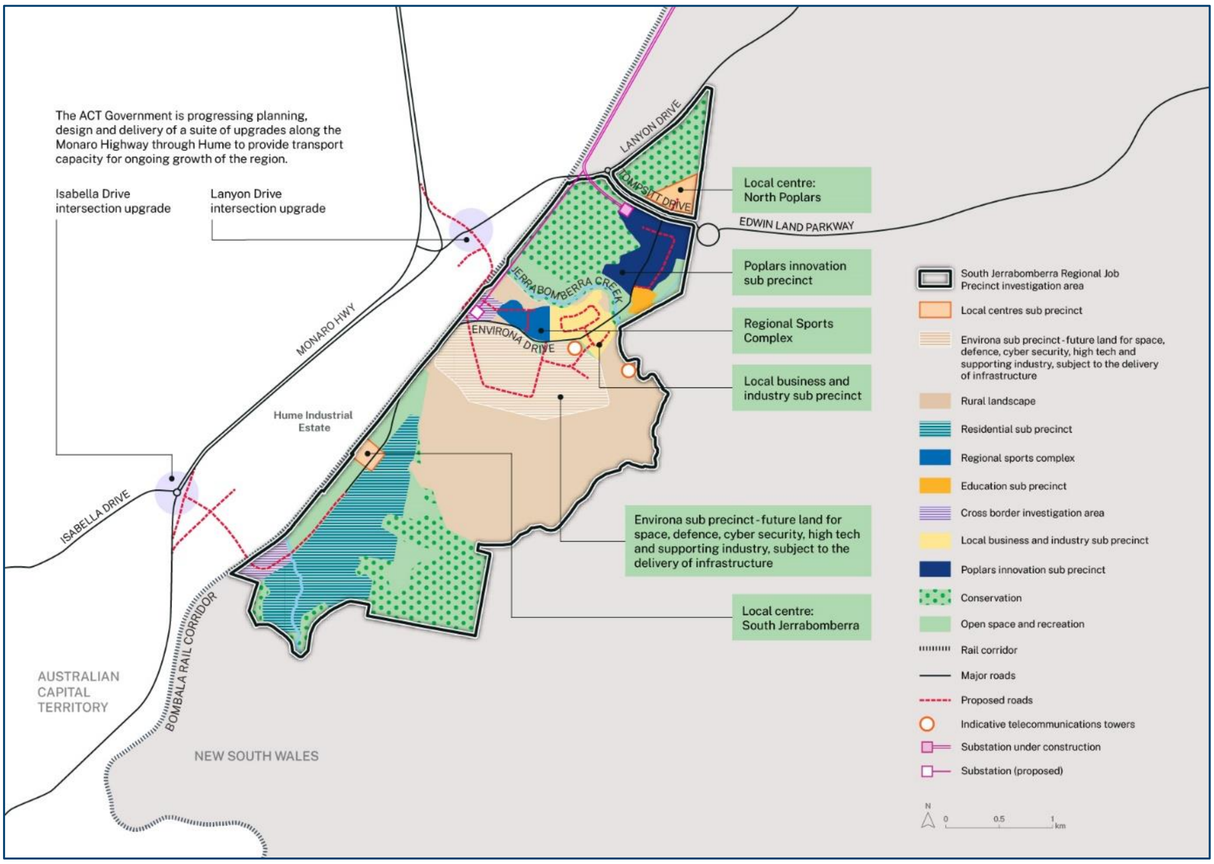

Figure 1-4: Draft Master Plan for South Jerrabomberra RJP

2 BASELINE ANALYSIS

2.1 Existing conditions

In general, air pollutant impacts are predicted to be significant in the southern half of the RJP investigation area, due to elevated terrain and prevailing winds. Stack sources have high potential to impact upon the elevated areas to the south of the RJP, as might be expected. It is to be noted that there is construction of residential developments occurring within these areas of predicted medium-high risk impact, due to stack emissions (and noise).

Odour emissions are dispersed uniformly from the sources with some bias towards the north-western section outside of the RJP investigation area. High odour emissions are predicted in the western section of the RJP where the local topography is relatively flat and low-lying and where temperature inversions are likely to occur.

For noise, the results are generally consistent with expected noise levels in proximity to an industrial area, when considering the local environment and proximity to sources. Similar to odour, noise emissions are predicted to be uniformly dispersed and are expected to significantly impact the western half of the RJP area due to the relatively flat terrain in the surrounding area. The modelling results show that due to insufficient buffer distances between the existing industrial activities in the ACT and the NSW residential developments being constructed in the RJP area, there is likely to be significant land use conflict in future.

The closest air quality monitor to the RJP investigation area that can be used to quantify local background air quality data is at Monash. This station has data available for NO_2 and CO only, hence other stations located within 250 kilometres (km) of the site are used to provide approximate data for the remaining pollutants. The data indicate that elevated particulate levels may arise in the general area, and short-term (24-hour average) particulate levels above the NSW EPA criteria are most likely to be associated with wider regional influences that affect the wider NSW region such as the state of ground cover (this is affected by rain/ drought conditions and agricultural activities), bushfire and hazard reduction burns. The annual average background dust levels are typically below the NSW EPA criteria for PM_{10}, however can be above for $PM_{2.5}$ due to the bushfires affecting air quality in late 2019 and early 2020.

Other pollutants such as NO_2, CO and O_3 may exceed the NSW EPA criteria on rare occasions and such effects could be attributed to the phenomena like the 2019 and 2020 bushfires. The atmospheric levels of NOx and VOCs in the atmosphere lead to the formation of O_3 and continuing growth in the sources of NOx and VOCs will exacerbate this. The majority of these emissions originate from combustion.

2.2 Existing industries

The existing industrial/ commercial operations that can generate some form of air, noise or odour emissions identified within and surrounding the South Jerrabomberra RJP investigation area are set out in **Table 2-1**. The location of these existing industrial/ commercial operations are shown in **Figure 2-1**.

These operations include a mix of industries such as waste management and recycling, asphalt making, manufacturing, landscape supplies, and other such operations. The key substance (either air, noise or odour) for each of the operations is shown with an assigned amenity classification based on the scale of the operation and the likely potential to cause environmental air, noise or odour impacts.

Table 2-1: Existing Industries

Company	Description	Map identification number	Key substance emitted	Amenity classification
Boral Asphalt	Asphalt plant	1	Air	Low
Boral Mugga Lane Quarry	Quarry	2	Air	Low
REGYP Canberra	Recycling centre	3	Air	High
Mugga Lane Resource Management Centre	Waste Treatment and disposal	4	Air	Medium
Corkhill Bros	Landscaping and supply service	5	Air	High
ACT Recycling	Recycling centre	6	Air	High
Re.Group	Resource recovery and recycling	7	Air	High
Direct Freight Express	Freight forwarding service	8	Noise	Medium
MRF	Recycling centre	9	Air	High
Capital Auto Recyclers	Mechanic	10	Air	High
Top Cash and Car Removal Canberra	Wreckers/recycling cars	11	Air	High
Steel Trusses Tech Australia	Steel truss manufacturers	12	Air	High
Bridgestone Service Centre Hume	Tyre shop	13	Air + Noise	High
Transpacific and Cleanaway, Alderson Place, Hume ACT	Waste management service	14	Air	High
Ampol Hume Diesel Stop	Petrol station	15	Air	High
Elvin Group	CBP	16	Air	Medium
Hume Bodyworks	Mechanic	17	Air	High
Bakehouse Hume	Bakery	18	Air	High
Profection Automotive	Mechanic	19	Air	High
Ullrich Aluminium Canberra	Aluminium supplier	20	Air + Noise	High
Cleanaway Hume Solid Waste Services	Rubbish collection service	21	Air	High
Roadmaster Refrigerated Transport	Transportation service	22	Noise	Medium
DB Schenker Couriers	Logistics service	23	Noise	Medium
TGL Customised Solutions	Storage facility	24	Noise	High
Sims Metal Management Canberra Scrap Metal Yard ACT	Metal recycling (Crushing/shredding)	25	Air + Noise	Medium
Star Track Express	Logistics service	26	Noise	Medium
Mainfreight Transport	Freight forwarding service	27	Noise	Medium
Caltex Woolworths	Petrol station	28	Air	High
Downer Hume & Asphalt Plant	Asphalt plant	29	Air	Low
Hume Off Road Centre	Mechanic	30	Air	High
Toll Express	Logistics service	31	Noise	Medium
FedEx World Service Center	Logistics service	32	Noise	Medium
Top Spec Automotive	Mechanic	33	Air	High
Bradbury smash and restorations	Mechanic	34	Air	High
Pharleys Spares & Repairs	Mechanic	35	Air	High
Sodablast Canberra	Sandblasting service	36	Air	High
Canberra Sand and Gravel - Hume Yard	Landscaping and supply service	37	Air	High
Lo Pilato Bros	Landscaping and supply service	38	Air	High
Cummins Canberra	Engine and generator manufacturer	39	Air	High
Queanbeyan Quarry	Construction Material Mining	40	Air	Low

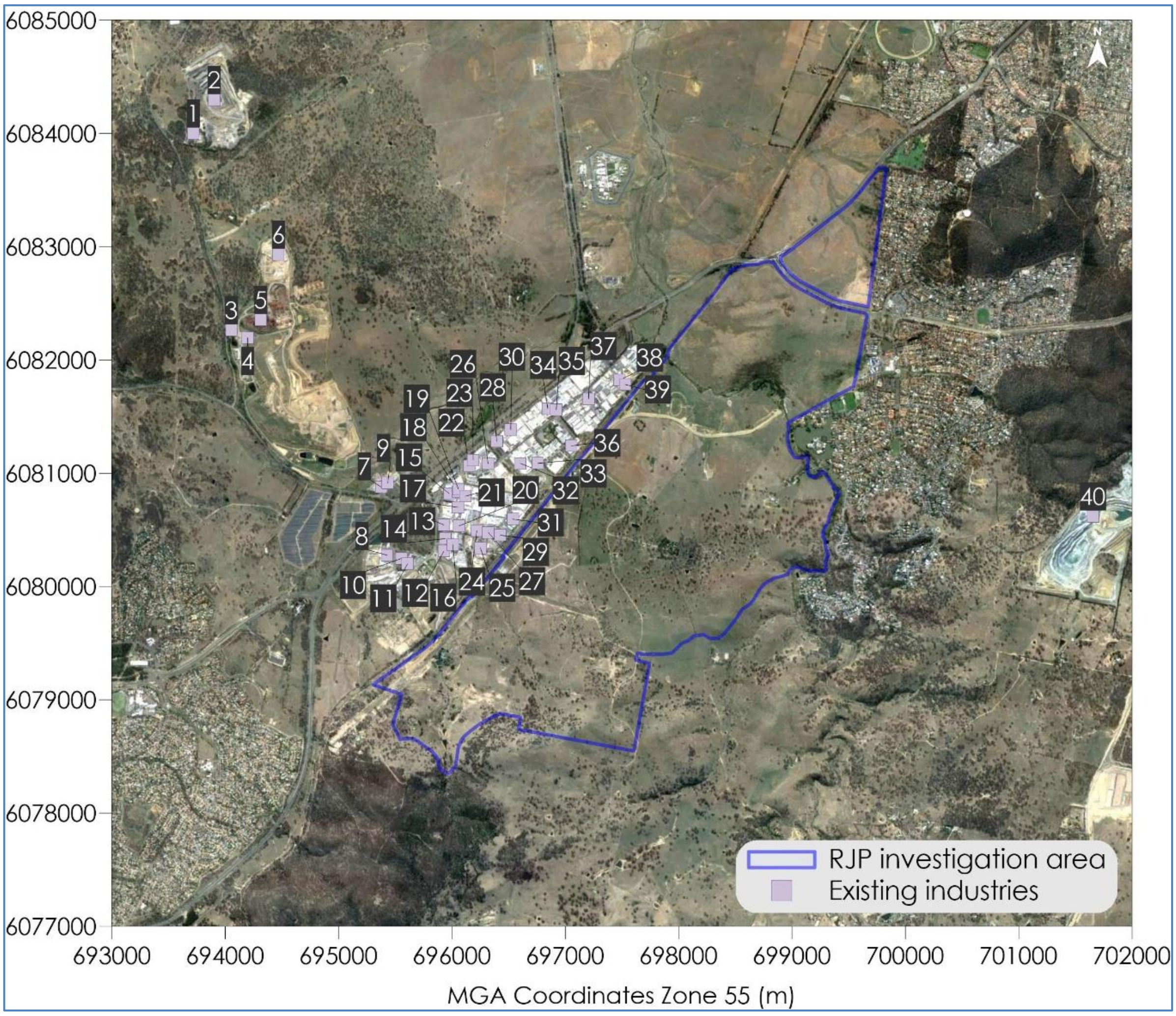

Figure 2-1: Existing industries

2.3 Analysis of modelling predictions for existing industries

Modelling predictions are presented based on a risk scale in terms of impact. The risk scale is provided to show the effect of dispersion/ emission from the existing sources due to the existing local terrain and winds, rather than to indicate compliance/ non-compliance of the existing industries with the relevant criteria. The shape of the modelling results is used to inform the shape of the buffers required and the risk profile of the land within the industrial area to be zoned and where like industries are best allocated.

The predicted maximum 1-hour average impacts for the modelled existing point sources are presented in **Figure 2-2**. The modelling results are presented on a risk-based scale to demonstrate the areas of potential impact from each of the modelled existing sources. The results indicate that high risk impacts generally occur closest to the source and are biased significantly towards the southeast extending over the RJP investigation area. This would be due to the prevailing rising terrain and wind conditions.

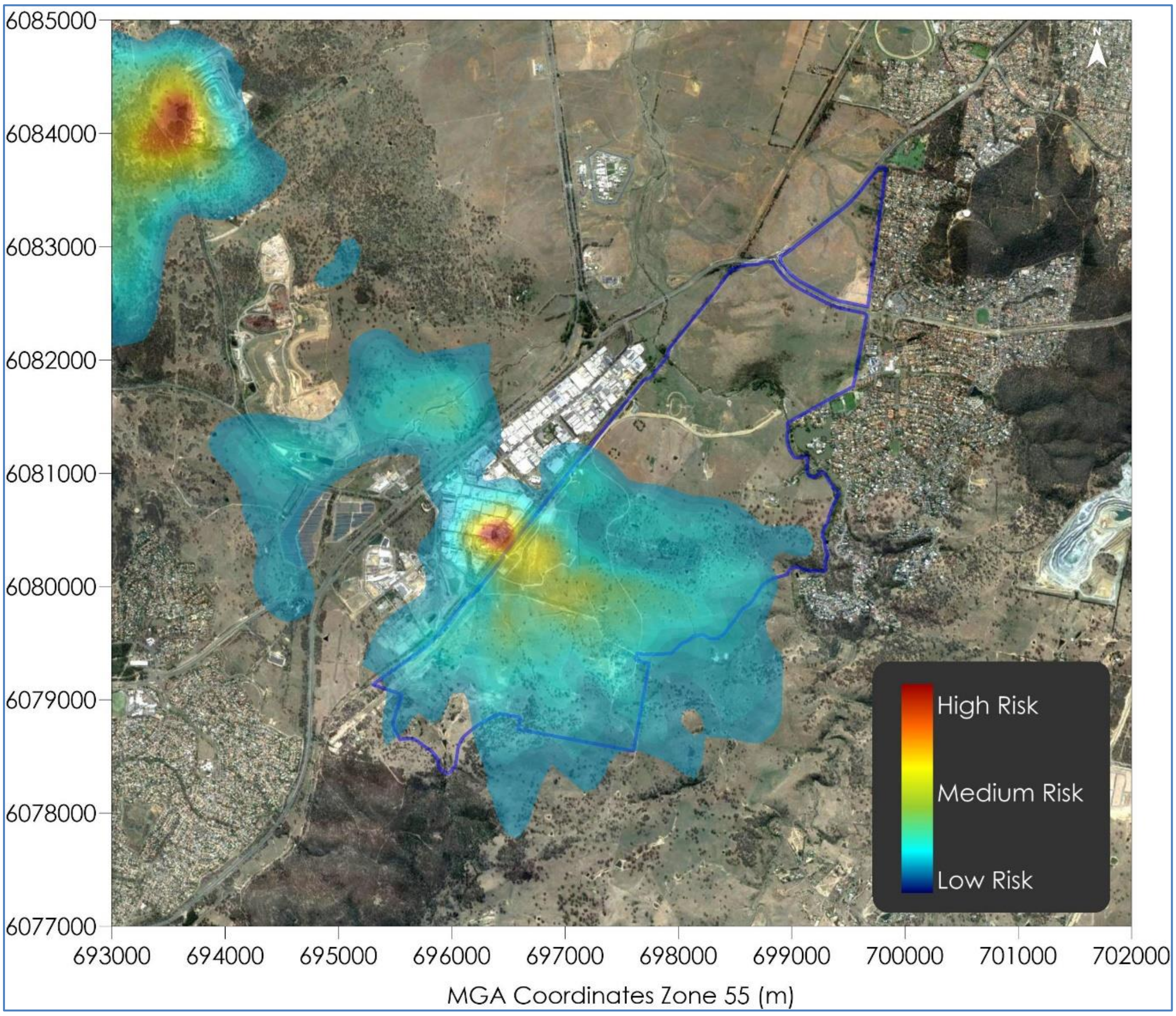

Figure 2-2: Predicted maximum 1-hour average impacts – Point (stack) sources

Figure 2-3 presents the predicted 99th percentile 1-hour impacts for the modelled fugitive sources which are representative of potential odour impacts. Similar to the results for point sources, high risk impacts are typically close to the source but decrease more significantly with increasing distance.

The modelling indicates that impacts from ground-based air and odour sources are likely to be relatively uniform in all directions, with some small bias towards higher impacts in the south-eastern quadrant based on the prevailing wind conditions. Due to new residential development in close proximity to the existing industrial area, there is potential for land use conflict if sufficient buffer between these land uses is not accounted for.

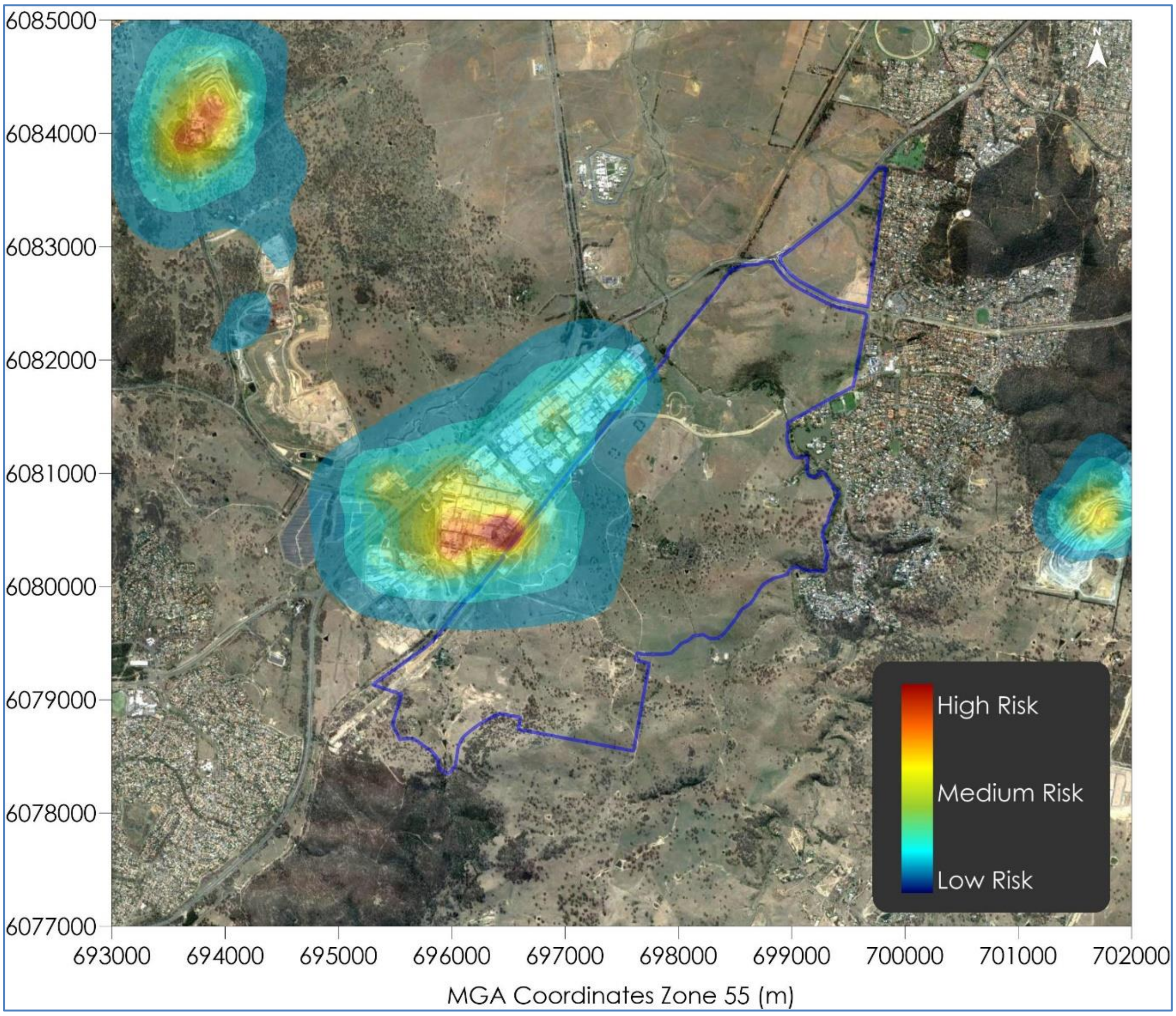

Figure 2-3: Predicted 99th percentile 1-hour average impacts – fugitive sources

Figure 2-4 presents the predicted worst-case 15-minute period noise levels for the modelled sources. The results show the highest risk noise areas are closest to noise sources (as would be expected), in the elevated terrain and also in the southeast quadrant.

The propagation of noise towards the southeast quadrant appears to be notably influenced by the local rising terrain in the area.

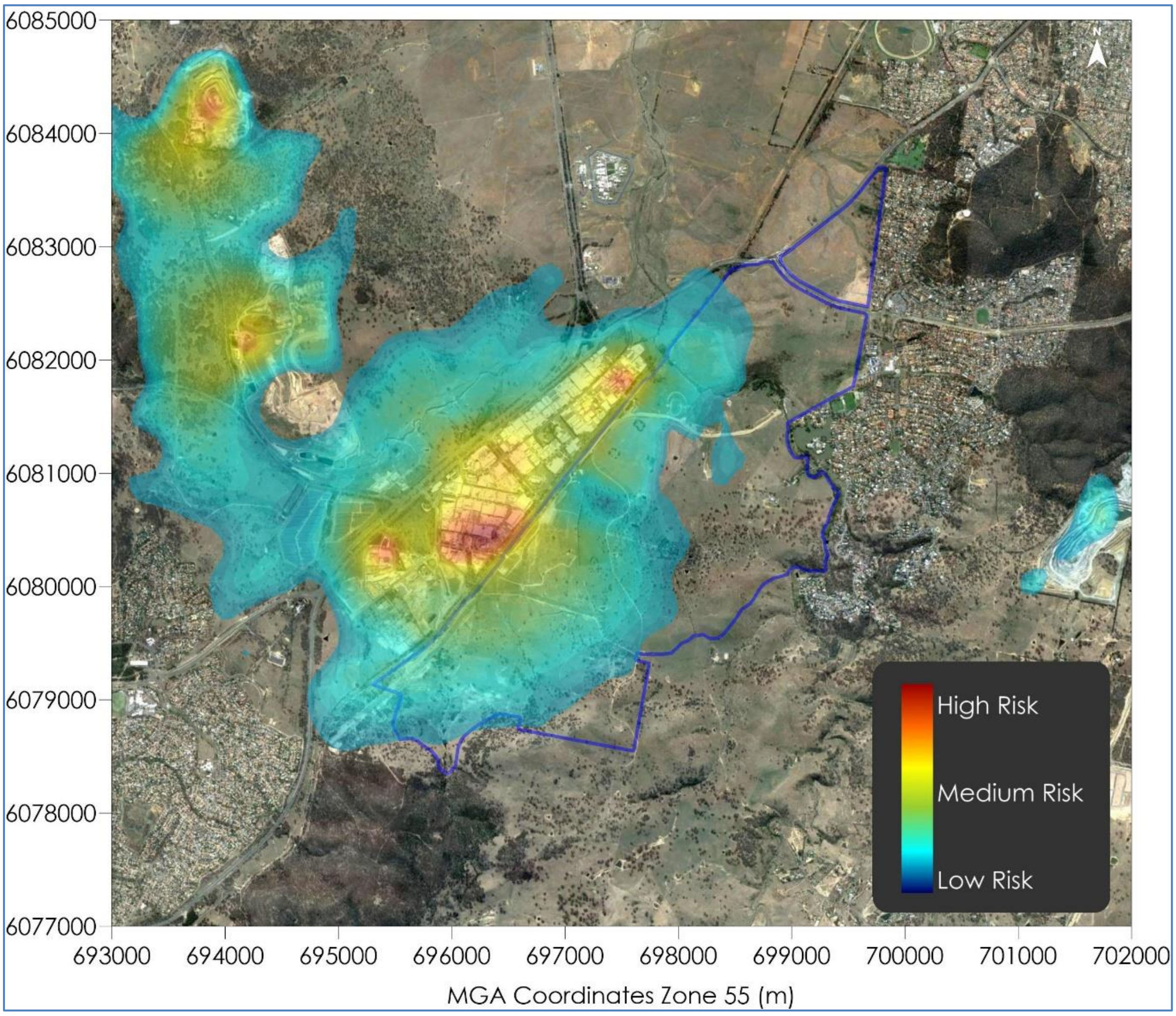

Figure 2-4: Predicted worst-case 15-minute period noise levels

2.4 Constraints and Opportunities

2.4.1 Constraints

The analysis shows a likely medium risk level of impact between existing industries and receptors. The impact, or land use conflict, arises due to the relatively close proximity of these existing receptors to existing industrial activities.

Overall, the following can be determined:

- The highest risks of impacts arise due to emissions from stacks upon elevated terrain around the RJP, or from noise or odour or dust emitted near ground level. Potentially they may be existing air quality, noise or odour impacts or levels near to criteria at some nearby residential receptors or the currently under construction residential areas in the southwestern parts of the RJP investigation area.
- To minimise or prevent future impacts arising, the next stage of the technical work will define appropriate setback or buffer areas around the existing sources of emissions in the RJP investigation area. This work would also define an appropriate allowance of air emissions for

industries within the RJP investigation area required to meet the relevant air quality criteria at these locations (or other suitable measures for use in planning instruments).

- Impacts from the existing volume sources, such as ponds, land surfaces and fugitive emissions from yards and buildings predominantly relate to odour emissions. Emissions from stacks include odour, but also toxic air pollutants. The volume sources tend to cause impacts near to the source and tend to concentrate in low-lying areas. The existing stack, noise and ground level sources all have potential to impact in areas in the south-eastern quadrant, and care should be taken to minimise any further residential encroachment towards industrial activity in that area.

- The stack (or point) sources tend to impinge upon the surrounding high points of the landscape, and extensive residential development in these elevated areas would be undesirable if stack-reliant industries are to continue in the future.

2.4.2 Opportunities

The following opportunities aim to manage potential land use conflicts and enable industries to operate without undue compliance burden while at the same time provide residents with adequate amenity and health protection.

- Co-location of high impact industrial uses to minimise buffer requirements. This should extend to clustering such uses with an industrial area. Generally, one should locate such high impacting industry clusters furthest from residential areas, but it is best to use the air dispersion modelling results to identify the locations affording the most scope for emissions to occur without undue impacts arising.

- Delineating a suitable buffer between existing and future residences and any major new industrial developments.

- The future residences or sensitive receptors within the RJP investigation area would limit the potential for major industrial development nearby, especially due to the dominant south-easterly and westerly wind flows. However, the necessary buffer can be determined via the modelling to be conducted in the next stage of the technical work. A likely strategy for this area may be via staged planning approaches for progressively expanding development within the RJP investigation area to defer or allow time to deal with this constraint.

- Introduce vegetation bands within the industrial area. Buffers nominally 50-100m wide which consist of dense, tall vegetation will add dispersion and dilution of fugitive or volume emissions, however this strategy may not assist greatly if new sources are predominantly from stacks. This strategy is best compatible with minimising visual impacts, which in-turn assists to minimise community perception of any potential odour impacts.

- The most likely impacted area in the southwest of the RJP is presently being developed for residential use. Land use conflicts are likely to arise due to existing industries in the ACT, even with fitment of highly effective odour mitigation. It may be reasonable to expect that some of these industries will not be able to feasibly continue to operate in their present locations for very long after residential occupation occurs, and thus alternative industries may replace them.

It would be sensible to consider potential opportunities in the RJP for locating these stack-reliant industries, noting that any such re-location from the ACT would in turn open up vacant sites for lower impacting industry.

2.5 Existing and potential future residential development

The existing and potential future residential development surrounding the South Jerrabomberra RJP investigation area is an important consideration to minimise potential future land use conflict. **Figure 2-5** presents the South Jerrabomberra RJP investigation area with the identified existing residential dwellings (based on available satellite imagery) and current residential land zonings.

It is important to note that there are several existing residential dwellings located within the South Jerrabomberra RJP investigation area and an R2 zoning identified in the southwest portion of the RJP investigation area.

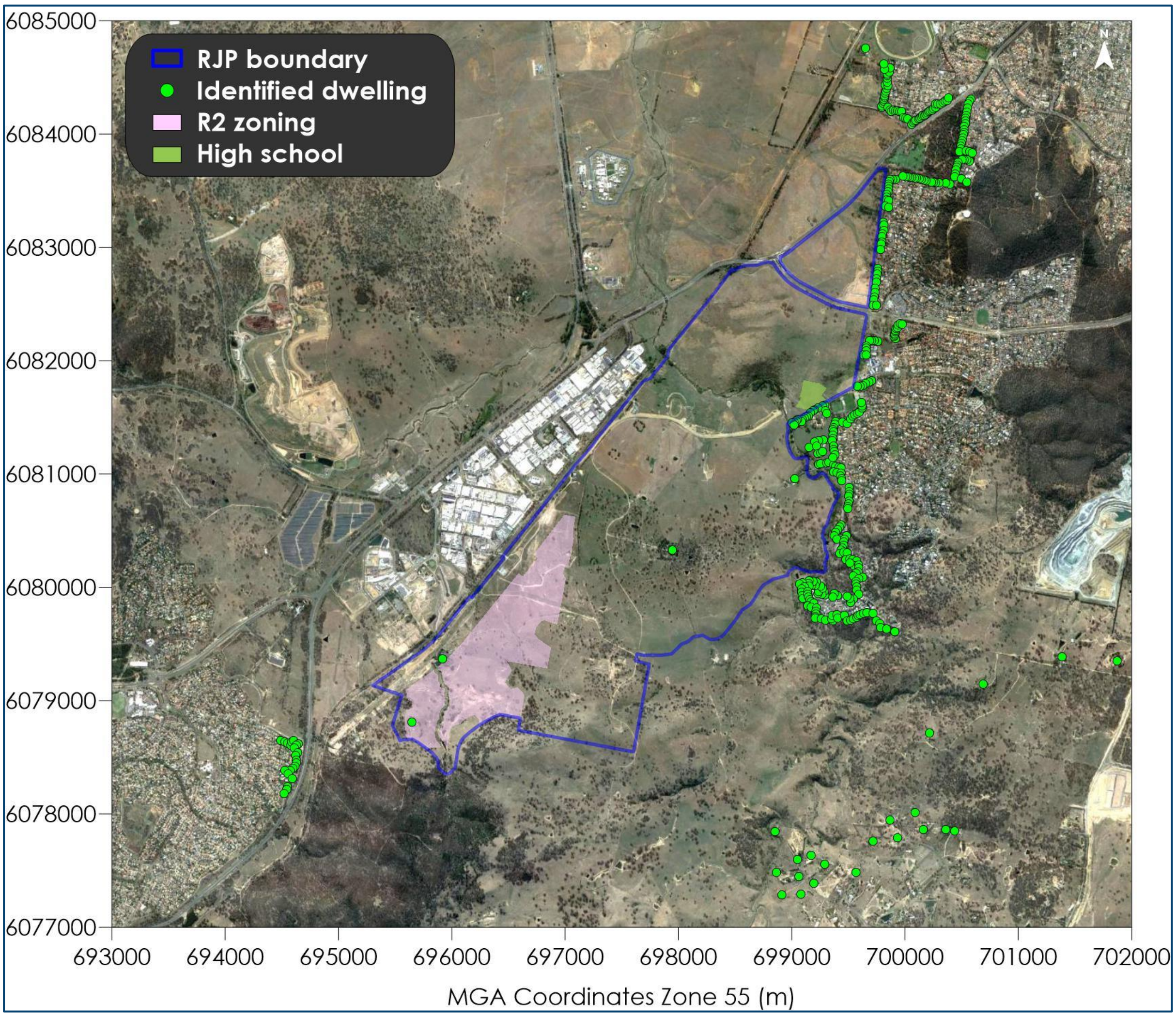

Figure 2-5: Existing and potential future residential development

3 MODELLING ASSESSMENT METHODOLOGY

3.1 Introduction

The relationship between the permissible level of air pollution emissions from any source (e.g., Regulatory limit) and the permissible level at receptor (i.e., ground level or ambient air quality criteria set out in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2016**)) was analysed to determine the limiting pollutants that will govern the findings of the air quality assessment. The limiting pollutants are those with the smallest ratio between the level that could be emitted (at the source) and the level permitted in the ambient air (at the receiver). This is the limiting pollutant ratio, as set in the applicable criteria.

For noise, we determined the difference between the sound energy released at the source and the applicable noise criteria at the receiver. This is the noise residual. The sound energy is derived for a typical array of noise sources in an industrial area, and the applicable night-time criteria (assuming 24/7 operations) will govern the noise residual (limiting case). For a 24/7 operation, it is taken that the sound energy from the source is the same, but the criteria are less stringent. Thus, when the night-time criteria are met, the evening and daytime criteria are also met. It is noted that even if there happens to be more noise energy released from the source in the evening or daytime, the less stringent criteria almost always adequately compensate for this.

The air pollutant levels (for any air pollutant) at the source are related to the level at the receiver by the degree of air dispersion or dilution of the pollutant as it travels from the source to the receptor. In a similar way, for noise, the sound energy at the source is related to the noise level at the receiver by the degree of noise attenuation between the source and receiver. Thus, for air pollution we apply a ratio, division or multiplication calculations, and for noise we use subtraction or addition calculations, but otherwise the same big picture principles apply.

Air dispersion modelling was used to determine the dilution ratio between all potential sources and all receptors (the modelling method is detailed later). At any receptor where the air dilution ratio approaches the limiting pollutant ratio, there is a high risk of exceeding the criteria for the limiting pollutant i.e., a high risk of air quality impacts arising. Medium and low risks are also defined according to the range of source emissions that can be expected to arise from industrial sources, and/or for other pollutants.

Similarly, noise modelling was used to determine the noise attenuation between all potential sources and all receivers (the modelling is detailed later). Risks were assigned on the same basis as air, i.e., per the limiting criteria at the receiver. Thus, at any receiver where the noise attenuation approaches the noise residual, there is a high risk of exceeding the criteria and a high risk of noise impacts arising.

The modelled outputs are therefore presented as risk levels to allow the risks from several pollutants, which may be dispersed differently (see later), but also noise to be compared on a like-for-like basis. The ability to make a valid comparison between all types of industries, air pollutants and noise pollutants is crucial for making good planning decisions.

The NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**2016**) define a range of criteria for many air pollutants. However, the pollutants can be categorised in simple terms according to how they are released. In general:

- Stacks will release; air toxics (such as metals, dioxins etc.) after capture and treatment, and common criteria pollutants (such as SO_2, NO_2 and fine particles) from a combustion process or a material handling process.
- The key fugitive emissions are dust and odour. These emissions may arise from wind erosion of an exposed site (dust), a pond (sewage, or process water odours), the openings of a building (paint fumes, dust, welding fumes etc.), or a land surface (manure, compost etc.).

How the pollutant is released is the key factor in determining the type of industry, and also the degree of dispersion between source and receiver.

In general, fugitive emissions result in most impact nearest the source and at ground level nearby, with less and less impacts as one moves further away. The spatial extent of the impact is usually governed by low wind conditions and inversions with the greatest impacts tend to be confined in a valley.

Noise, and especially noise at night-time, is most affected by inversions and gradient winds and is most similar to the fugitive sources. However, noise propagation is significantly affected by barriers, thus the terrain is a key factor. Similar to the fugitive sources, noise impacts can be confined within a valley (if the source is in the central part of the valley and the valley terrain is significant).

Unlike fugitive sources and noise, stacks are designed to disperse pollutant away from the ground. Emissions released from stack will have their highest impacts on the surrounding elevated terrain, and often somewhat away from the source. Placing stacks at the bottom of a valley is generally counterproductive as taller, more costly stacks will be needed to prevent impacts. On the other hand, whilst stack sources would ideally be placed atop ridges and hills, the types of industries that have stacks are generally large, and visually such industries can be an imposing eyesore (in the view of many).

Knowing the above, the air dispersion modelling between source and receiver could be limited to stacks and fugitive sources. The limiting pollutant ratio for stack emissions was determined to be air toxics for stack emissions, and odour for fugitive sources.

The air and noise modelling factors in the prevailing weather and terrain conditions for the specific locality.

For both the air and noise modelling, the modelling was "reverse engineered" such that the same risk profile could be applied to the sources as well as the receivers/ receptors. This was done so that it is possible to tell which sources cause the impact at receptors. Only high risk sources can cause high risk impacts. Removing either the high risk source or high risk impacted receptor (or both) eliminates the risk of impacts arising.

The modelling was then set up to allow this to be done quickly and to iteratively arrive at an optimal separation between source and receptor that would minimise impacts. Further refinement of the modelling was made to factor in low, medium and high amenity sectors to be developed, according to the types of industry that would emit low, medium or high levels of air pollution or noise.

Technical details of the modelling are set out in the next section.

3.2 Technical detail of air dispersion and noise modelling methodology

The following sections are included to provide the reader with an understanding of the model and modelling approach.

The air dispersion modelling was undertaken using a combination of The Air Pollution Model (TAPM) and the CALPUFF Modelling System which include three main components: CALMET, CALPUFF and CALPOST. TAPM is a prognostic air model used to simulate the upper air data for CALMET input. CALMET is the meteorological component for use in the CALPUFF dispersion model. CALPOST is a post processor used to process the output of the CALPUFF model and produce tabulations that summarise the results of the simulation.

CALPUFF is an air dispersion model approved by NSW EPA for use in air quality impact assessments. The model setup used is in general accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC Environmental Corporation (TRC)**, **2011**).

The noise modelling uses the Environmental Noise Model (ENM) which is compatible with the NPfI.

3.3 Meteorological modelling

The meteorological modelling methodology applied a 'hybrid' approach which includes a combination of prognostic model data from TAPM with surface observations.

The TAPM model was applied to the available data to generate a three-dimensional upper air data file for use in CALMET. The centre of analysis for the TAPM modelling used is 35° 23′ south and 149° 9′ east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 35 vertical grid levels.

The CALMET initial domain was run on a 10 x 10km with a 0.1km grid resolution for the 2018 modelled year. The available meteorological data for January 2018 to December 2018 from the Canberra Airport AWS and Tuggeranong AWS were included in the simulation. The 2018 calendar year was selected as the period for modelling based on an analysis of five consecutive years as outlined in **Appendix A**.

3.3.1 Meteorological modelling evaluation

The outputs of the CALMET modelling are evaluated using visual analysis of the wind fields and extract data. **Figure 3-1** presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period (i.e., example only). The wind fields follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

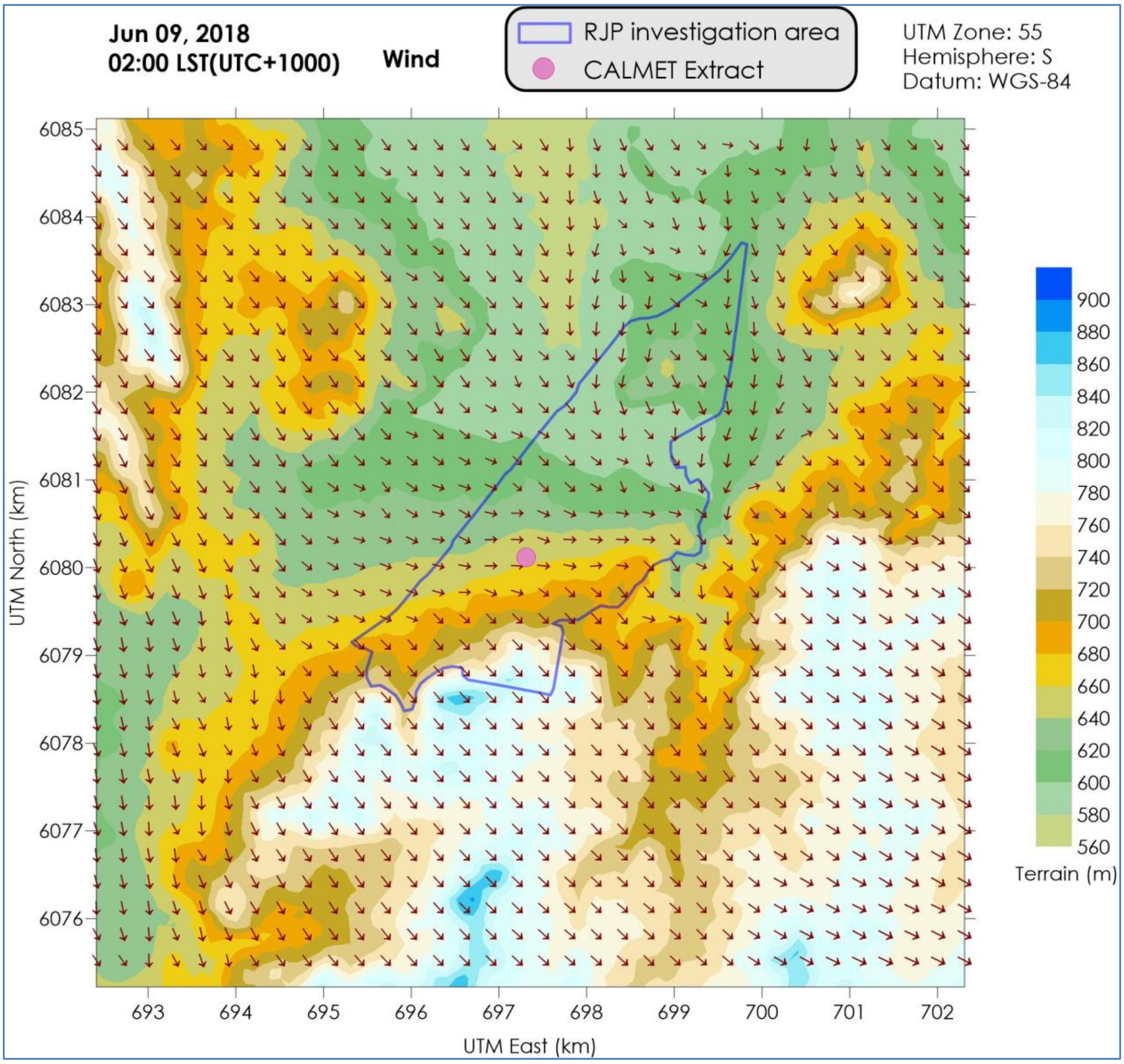

Figure 3-1: Representative 1-hour snapshot of wind field

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

Figure 3-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

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

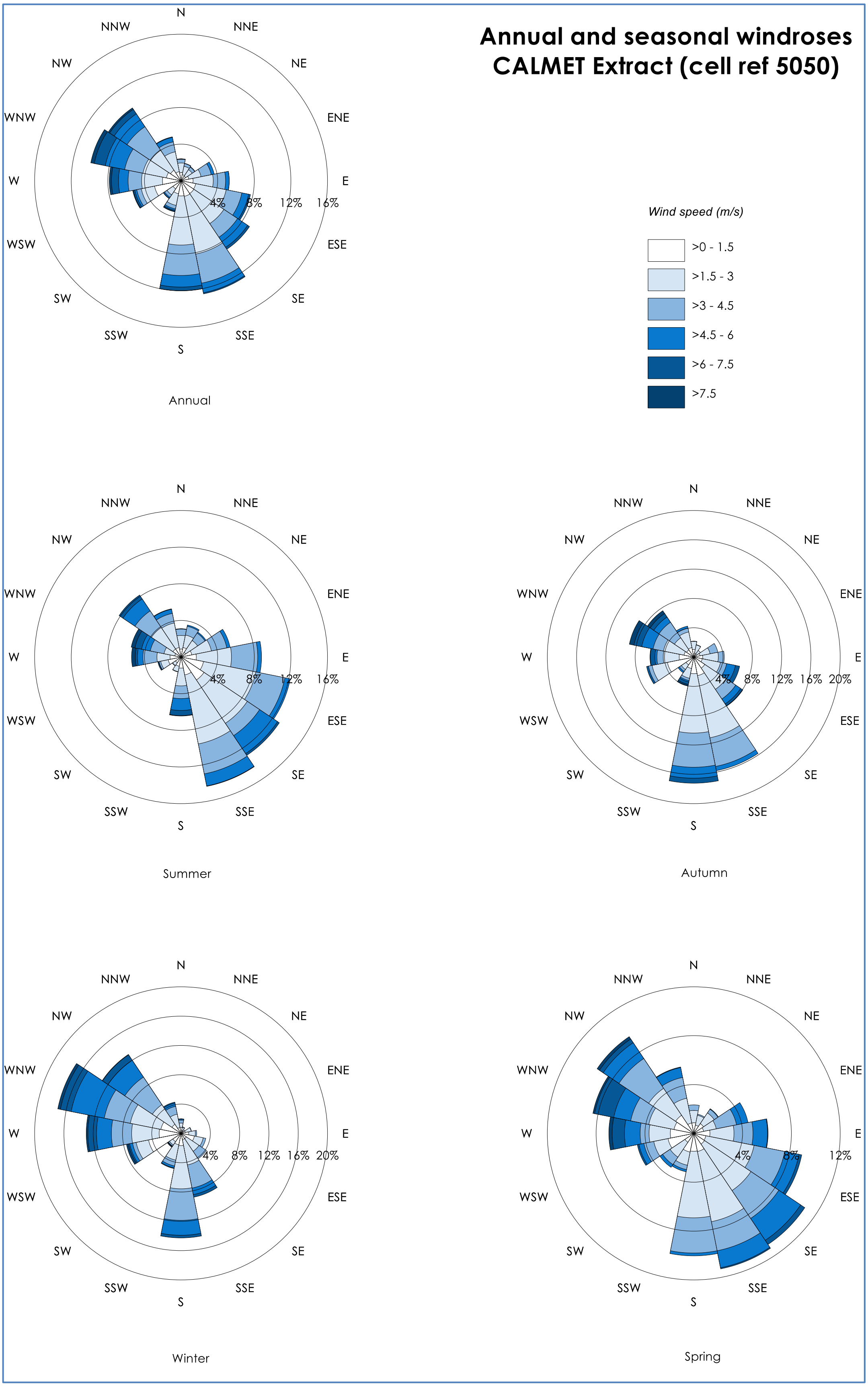

Figure 3-2: Annual and seasonal windroses from CALMET

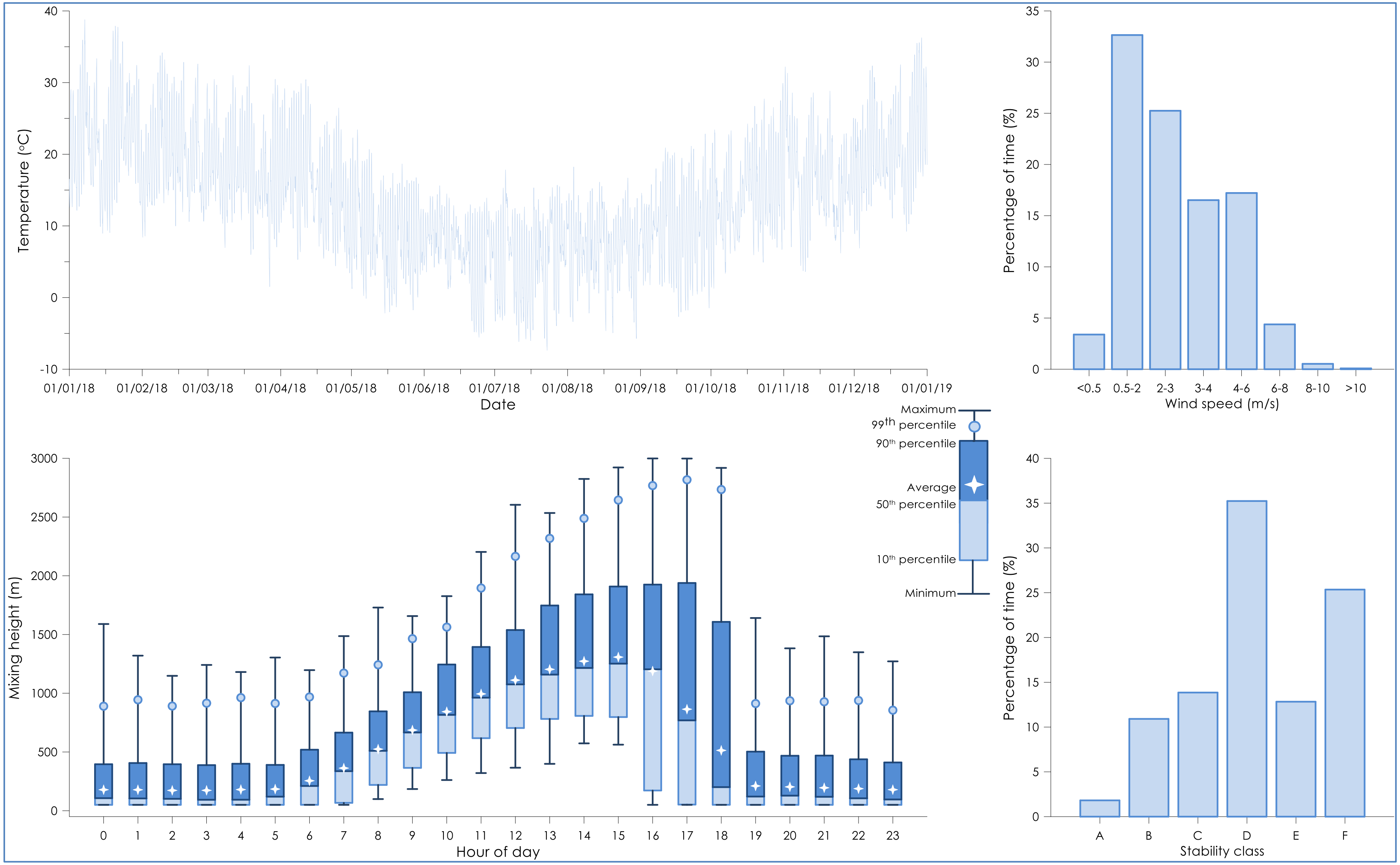

Figure 3-3: Meteorological analysis of CALMET

3.4 Air and odour modelling

The CALPUFF dispersion modelling is based on the emission of pollutants from sources within the meteorological modelling domain. The model was setup to include all potential future source locations arranged in a grid within the South Jerrabomberra RJP investigation area.

The sources represent any location within the South Jerrabomberra RJP investigation area where potential air emissions can occur. Each source was modelled separately as both a point (stack) source and as a fugitive (volume) source with emission release parameters that would represent relatively standard sources associated with the industrial activities and the assigned amenity classification. The point sources were setup to represent emissions from a stack with generalised flow parameters (e.g., exit velocity, temperature) and an emission point which is elevated above the ground. The volume sources represent diffuse, fugitive ground based sources which commonly include dust and odour emitting sources.

These sources were modelled over the entire year and are assumed to emit air emissions continuously using a unit emission rate. The emissions were modelled for only the key pollutants with scope to exceed EPA criteria. The different rates of emission of various key pollutants were accounted for, allowing source or receptors impact risk to be shown on a like-for-like basis, irrespective of the pollutant emitted.

3.5 Noise modelling

Noise emissions were modelled in a similar manner to the air emissions with all potential future industrial source locations arranged in a grid within the South Jerrabomberra RJP investigation area.

Industrial movement and handling of freight has been accounted for in each industry as part of the different industrial uses, however the movement of vehicles (such as via rail or road) along public roads and highways are not specifically included. The noise arising from vehicles on public roads is assessed differently to noise from industrial sources, and per different guidelines which are more conservative (less stringent) that the assessment made. There is no tangible risk that traffic noise from public roads in the RJP would exceed the applicable road criteria, and thus no further investigation is warranted.

The industrial noise sources were modelled using the ENM noise model under strong inversion conditions and generalised noise emissions profiles typical of the different industrial activities.

3.6 Modelled receptor locations

Figure 3-4 identifies the modelled receptor boundary for the South Jerrabomberra RJP investigation area where potential air, noise and odour impacts are assessed. The modelled receptor boundary accounts for the nearest existing residential dwelling or potential future dwellings based on current land zonings surrounding the South Jerrabomberra RJP investigation area. This proposed high school in the Master Plan to the east has also been included as potential receptor location.

The Hume Industrial area is not considered as a sensitive receptor area as these are industrial activities and not expected to be affected by air, odour and noise emissions from similar industrial activities associated with the RJP.

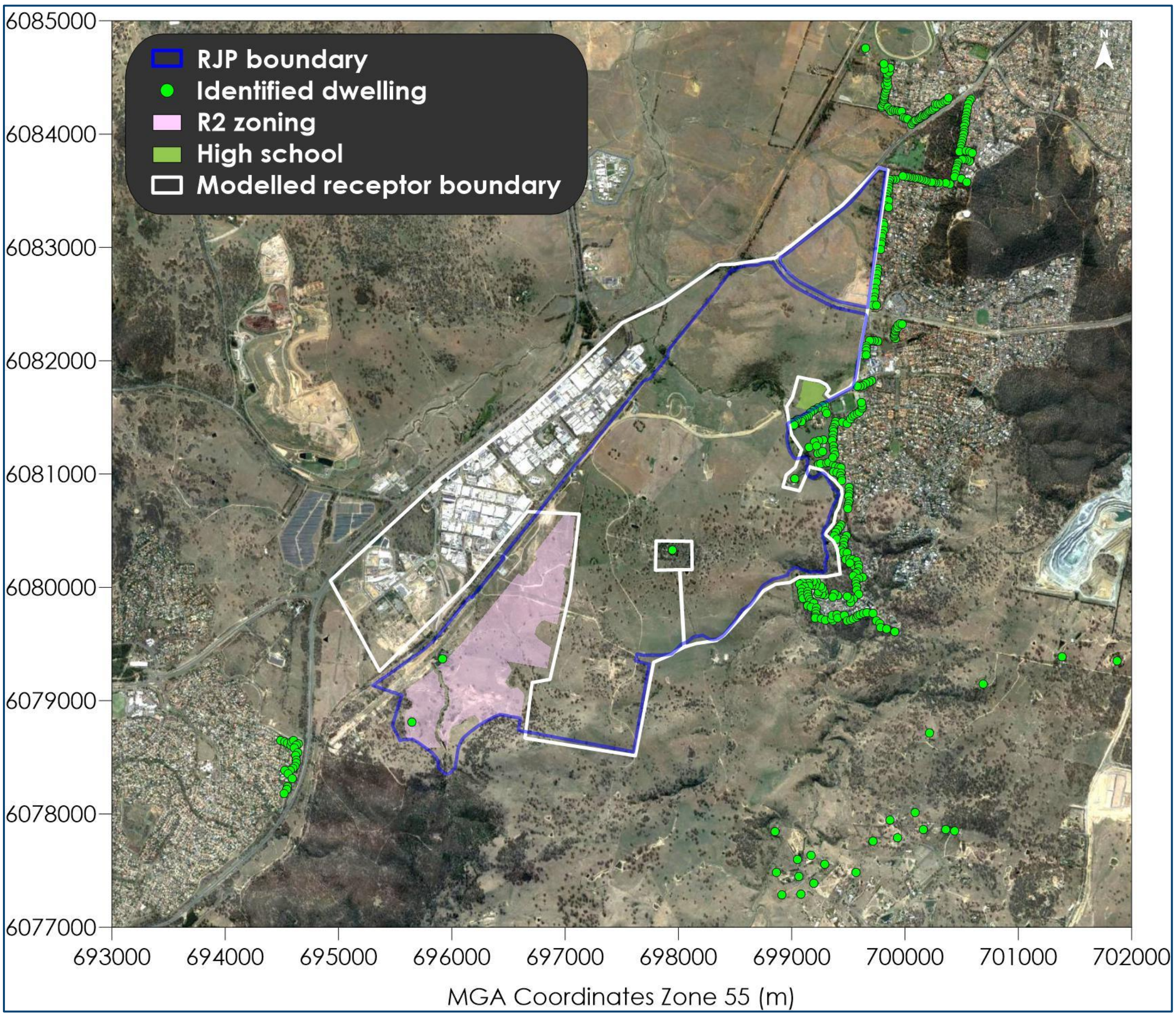

Figure 3-4: Modelled receptor boundary

3.7 Modelling assumptions and limitations

The assumptions and limitations include:

- Existing vacant land beyond the South Jerrabomberra RJP investigation area boundary is treated as a buffer, based on its current zoning and potential to provide sufficient protection for all existing sensitive receptors and existing and future industrial activities. Refer to land located between blue boundary and white boundary in **Figure 3-4**. It is assumed that appropriate planning mechanisms would be applied to this land to prevent residential encroachment or other sensitive uses which can lead to future land use conflict.

- Sources were assumed to be high/medium/low amenity based on the potential future land use and their likelihood to emit low, medium or high levels of air and odour pollution. For example, a low emitting industry in a high amenity area may include warehousing and distribution with only trucks and forklifts as the main air pollution sources. A high emitting industry in a low amenity area may include industrial manufacturing or waste processing with fixed air pollution sources.

- Sources were modelled over the entire year and are assumed to emit air emissions continuously using a unit emission rate over the entire area. For this assessment is has been assumed that all sources operate 24/7.
- Industrial movement has been accounted for within each amenity area, however the movement of vehicles (such as via road) into and out of the RJP are not specifically included. These are seen as transient sources and are assessed differently to fixed industrial sources.
- There is also no distinction between scheduled and non-scheduled activities in the modelling.

3.8 Master Plan testing

The draft Master Plan described in **Section 1.6** was tested using the approach outlined previously to identify the areas at risk of potential impact upon existing or potential future receptors and associated land use conflict.

The dispersion risk results for air quality include both volume sources and stack sources combined showing a single prediction for each of the scenarios. The combined result shows the maximum risk of either air quality or odour issues arising at the receptor locations.

Different amenity areas are assigned to the proposed land uses in the draft Master Plan and represent low, medium or high potential for air, noise and odour emissions and factor in the types of industry and activities that may occur in these areas.

The amenity areas assigned for the draft Master Plan are presented in **Figure 3-5**.

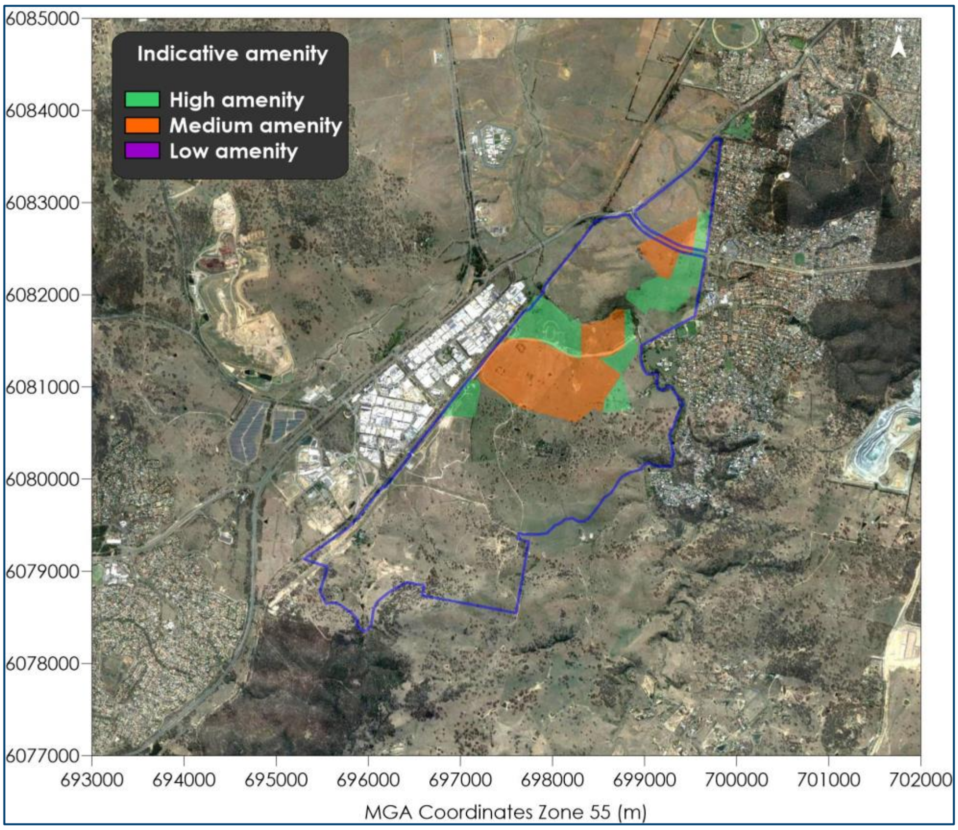

Figure 3-5: Draft Master Plan - indicative amenity area

4 ANALYSIS OF MODELLING RESULTS

Figure 4-1 presents the potential constraints due to air and odour emissions at the receptors and source locations, respectively, for the draft Master Plan. The risk classifications for the figures in this section are used to highlight potential risk areas that need to be addressed when refining the Master Plan[1].

Figure 4-1 shows that potential medium risk areas are identified in areas where light to medium industry are expected due to their proximity to sensitive receptor locations. The highest risk areas are located in the middle of the RJP and are primarily driven by stack sources due to the impacts which occur on the rising elevation south of the industrial area.

[1] The numerical basis for the potential impact/ risk is shown in the figures in the next section, however it is for the final Master Plan, that has been refined in response to the initial modelling shown here.

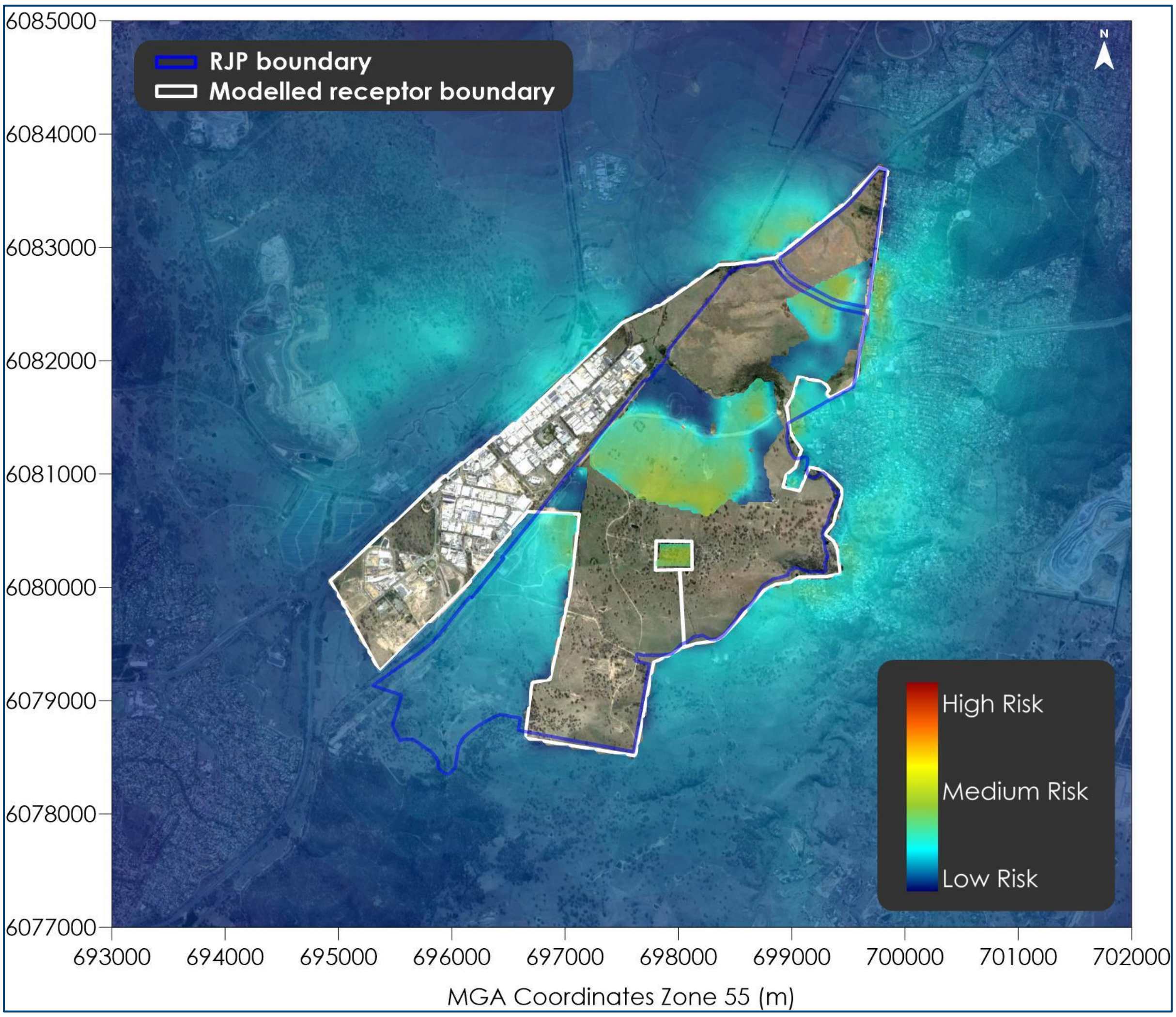

Figure 4-1: Air and odour modelling results for the Master Plan

Figure 4-2 presents the potential constraints due to noise emissions at the receptors and source locations, respectively, for the draft Master Plan.

The predicted high-risk areas are largely to the east and between the R2 zoned land and the industrial land within the RJP.

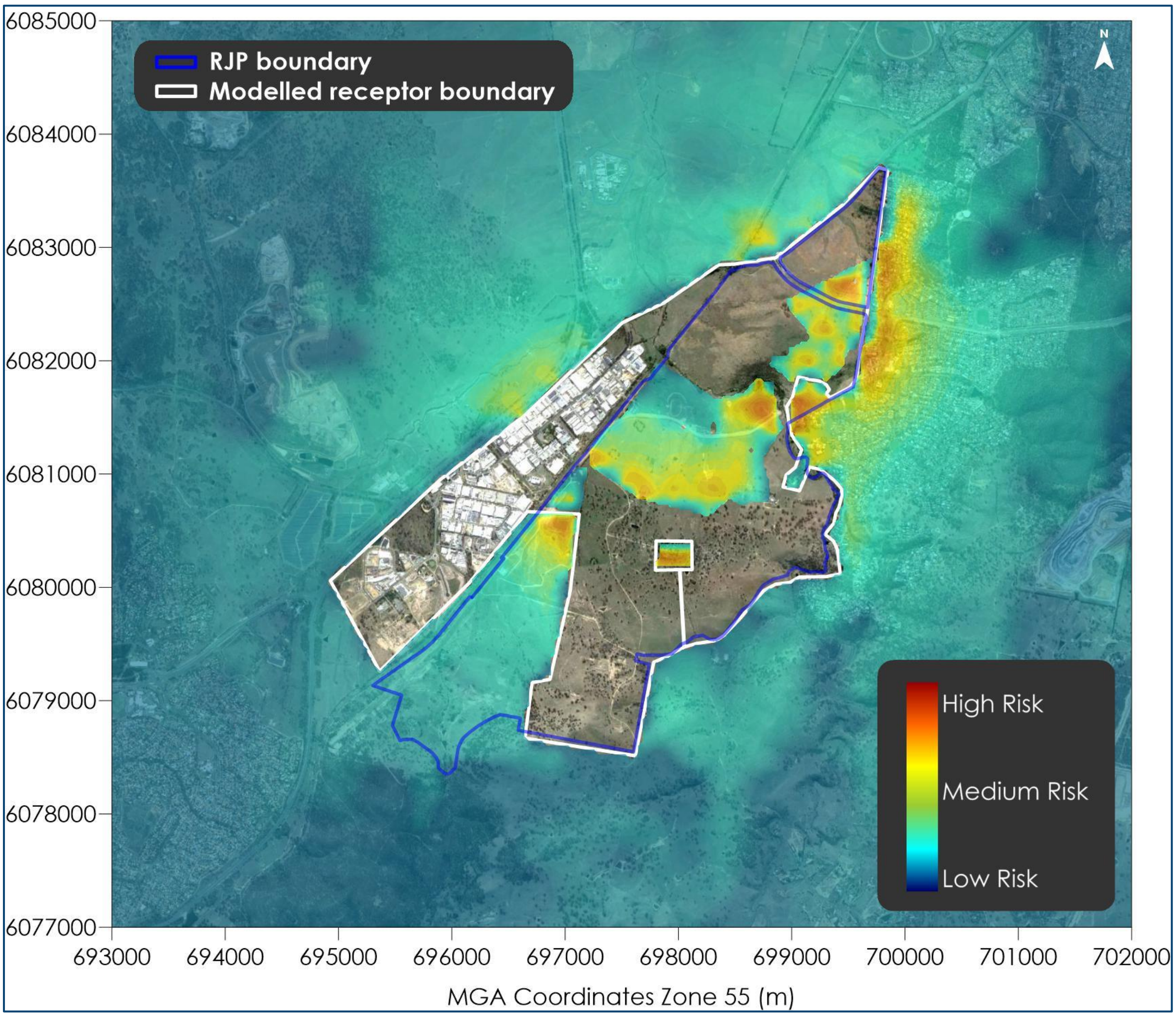

Figure 4-2: Noise modelling results for the Master Plan

4.1 Canberra Airport

The proximity to Canberra Airport will pose limitations on the development of the RJP area due to noise associated with the aircraft and the flight paths.

Figure 4-3 presents the Australian Noise Exposure Forecast (ANEF) contours for Canberra Airport. These represent the forecast aircraft noise levels based on approved flight paths for the airport. These are cumulative noise over a year and correlate to community reaction to aircraft noise (this includes consideration of different aircraft types, direction of travel, noise level, number, and time of movements). Development can occur in areas between the ANEF 20 and 25 contour however would be subject to acoustic attenuation, for example per *AS 2021:2005 Acoustics- Aircraft noise intrusion – Building siting and construction* and areas inside the ANEF 25 contour are generally considered unsuitable for development. It is understood that for Canberra Airport, new residential land use is not permitted within the ANEF 25 Contour. The RJP planning has ensured there are no new noise sensitive receptors within this contour, as such there is no known need to make a precinct wide referral to Canberra Airport, but it would be prudent to inform them of the RJP planning work.

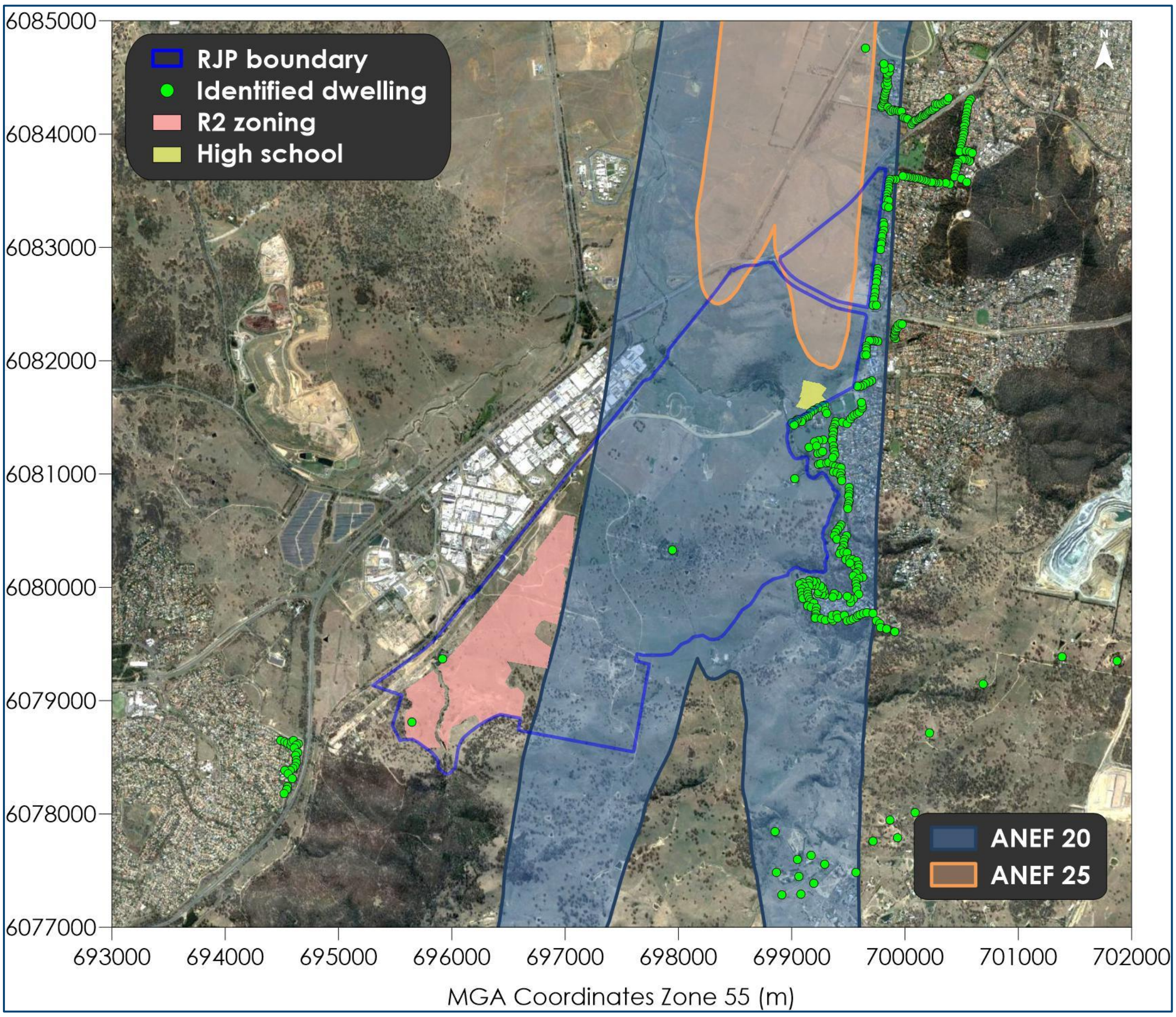

Figure 4-3: ANEF contours for Canberra Airport

5 ALLOCATIONS FOR AIR, ODOUR AND NOISE

Planning considerations to minimise or control land use conflicts for air, odour and noise are set out in this section.

The approach provides numerical criteria applicable to the land. This is only possible for noise and odour given that there is a limiting criterion for an emission (noise or odour), whereas for air, there are many criteria for many pollutants which apply at various locations and averaging periods. As such, only preferences or guidance can be provided for air emissions.

The key consideration in making the assessment is that there are no sensitive receptors within the precinct boundary, meaning that any existing receptors within the precinct boundary may become part of the buffer zone or may otherwise be re-zoned.

The objective of the modelling and assessment task is to define the maximum extent of emissions from within the industrial area that do not cause impacts, in this case outside of the precinct boundary. The corresponding noise and odour emissions from any part of the industrial area are also identified.

For air, only general good practice guidance can be provided.

5.1 Noise

Figure 5-1 shows the results for noise. The left-hand side of the figure shows sound power levels as 2dB contour lines up to 100dbA/ha and 1db thereafter within the RJP investigation area. The right-hand side shows the noise level outside of the RJP investigation area.

The contour lines within the industrial area represent the maximum attenuated sound power level per hectare (i.e., noise that can be generated at the site, per hectare).

The following formula can be used to convert the contour line value crossing the middle of a specific lot into that lot's permitted sound power level based on the lot size. Per the formula, bigger lots get more sound power, smaller lots get less.

Equation 1: $PWL\ (lot) = PWL(ha) + 10\ \log(A/10{,}000)$, where:

PWL(lot) = Allowed attenuated sound power level per lot, dB(A)
PWL(ha) = Sound power level of contour line crossing middle of the lot (OK to interpolate between lines);
A = Lot area in square metres

Upon subdivision, this sound power (PWL(lot)) can be set as a property right for the lot, perhaps as part of a Section 10.7 Notice attached to the property, and/ or as part of the total tally of lot sound power within a database or electronic register/ tool for managing the approval of developments in the industrial area.

From a regulatory view point, measuring PWL(lot) at the site is more swift, direct and reliable than measuring the intrusive noise level at receivers, especially for a lot within a large industrial area where it can be very hard to determine which source/ lot/ operation is causing the noise at the receiver.

From an application/ assessments/ approval point of view, this pre-set allowance for the lot's sound power level reduces the work a noise consultant may need to do, saving time and money. It may prompt some operators to design the plant to pollute up to the limit so to speak. However, in this approach the PWL(lot) is easily measurable and so potential transgressions can be swiftly and efficiently regulated.

Should a lot be found to exceed its allocation, the degree of sound abatement needed would immediately be known, and the normal (existing) process to ameliorate the noise can commence immediately (and be validated more swiftly and cheaply). In this regard, the approach provides scope for a potential future noise trading scheme or noise management precinct, which can minimise noise abatement costs. For example, rather than paying to further abate noise from its activity, the lot owner may be able to acquire some or all of the unused noise allocation from another lot. Whilst this is not proposed here, it is something that can potentially be set up if desired at a later time.

The right hand side of **Figure 5-1**, shows the sound pressure levels outside of the RJP investigation area.

As per the Noise Policy for Industry (**NSW EPA, 2017**), the limiting criterion is the amenity criterion of 40dB(A) which is a 9-hour average noise level over the night-time period (10pm to 7am) and applies to the cumulative noise of all industrial noise sources, whereas the intrusive criterion is 35dB(A) and applies to each individual site. As the noise sources in the industrial area will be a mix of constant sources (e.g., a fan or transformer which is always on) and intermittently noisy sources, such as vehicles and mobile plant, and other batch activities, many sources will only make noise intermittently over 9 hours. Therefore, the measured cumulative 9-hour noise level will be less than the maximum measured 15-minute level (from all sources) in that same 9-hour period.

The sound power limits above correspond with all lots operating at the individual intrusive noise limit for each lot which is set at 35dB, LAeq(15min) to protect the amenity of the nearest receptor outside of the RJP investigation boundary, and both limits are commensurate with the industrial area meeting the cumulative noise amenity level of 40dB, LAeq(9hr).

The pink line in **Figure 5-1** represents the required buffer area which is both the 35dB, LAeq(15min) individual site intrusive criteria compliance boundary line (or the location of the nearest sensitive receptors at which the intrusive criteria apply) and also the cumulative noise amenity level extent for 40dB, LAeq(9hr).

The land within the buffer line is not suitable for residential use. It is recommended that suitable strategies to prevent any new residential use and ideally to also progressively reduce any existing residential use in the buffer area over time should be developed.

5.2 Noise mitigation options

As for any operation in NSW, as a minimum, general or commonly used noise mitigation is expected for industries in the industrial area that have potential to release noise emissions.

The RJP investigation area and buffer is designed such that industries incorporating general levels of control should be able to operate within the industrial precinct without causing impacts. But there are limitations, for example a facility that would have high levels of noise emissions may need to have extra noise mitigation if it chooses to locate close to the edge of the estate near receptors. Such a location is better suited to an operation which has noise emissions within the specified allowance as it is unlikely to need extra abatement.

The left hand side of **Figure 5-1** provides an allowance per hectare for potential noise emissions. This can be used as part of the approvals process, where a proposed development with less emissions per hectare than the allowance for the proposed lot would be suitable. The figure also serves to help potential new industries to identify the more suitable lots where, depending on their emissions, the facility can reasonably expect to be able to operate without causing impacts (outside of the precinct boundary) or to require extra noise controls.

General mitigation options for industries to manage noise emissions would vary depending on the nature of the source and the effectiveness of potential mitigation options need to be considered in each case. Some examples of general noise mitigation measures include:

- Mitigation at the source;
  - Selection of equipment – select equipment with low sound power levels when purchasing new equipment or substituting equipment.
  - Modifying equipment – silencers, mufflers and dampeners may be retrofitted to existing equipment to reduce noise emissions.
  - Operational time – consider adjusting operating times for when equipment is in use.
  - Implementing quiet work practices – using equipment in ways to minimise noise, this includes reducing throttle setting and turning off equipment when not being used.
  - Maintain equipment – regularly inspect and maintain equipment to ensure it is in good working order.
  - Limit equipment use – reduce the amount of equipment operating simultaneously, avoid clustering of equipment.
- Mitigation along the path between source and receiver;
  - Barriers – construct barriers between source and receiver.
  - Direction – orient noise emissions away from receiver.
  - Distance – provide as much distance as possible between source and receiver.
- Mitigation at the receiver;
  - Barriers – construct barriers at the receiver.
  - Architectural treatments – treatment options depend on the level of noise at the receiver.

Considering the left-hand side of **Figure 5-1**, the results show that there are significant areas with appropriate sound power level allowances to be suitable for general industrial activities, e.g. 95 dB(A)/ha or higher, and the most poetically impacting industrial uses are in these areas of the Master Plan, which is good. However, constraints on noise emissions would arise where the results are below approximately 85d(BA)/ha, primarily for night-time noise affecting residential receptors.

The under-construction industrial area that straddles the 85d(B(A)/ha line is not ideal, but can be managed e.g., by requiring low noise activities, or no operation at night. Similarly, the sports complex located in the prime area for maximum noise emissions is not the ideal land use from a noise perspective, noting there are other factors that would govern how the best land uses are determined.

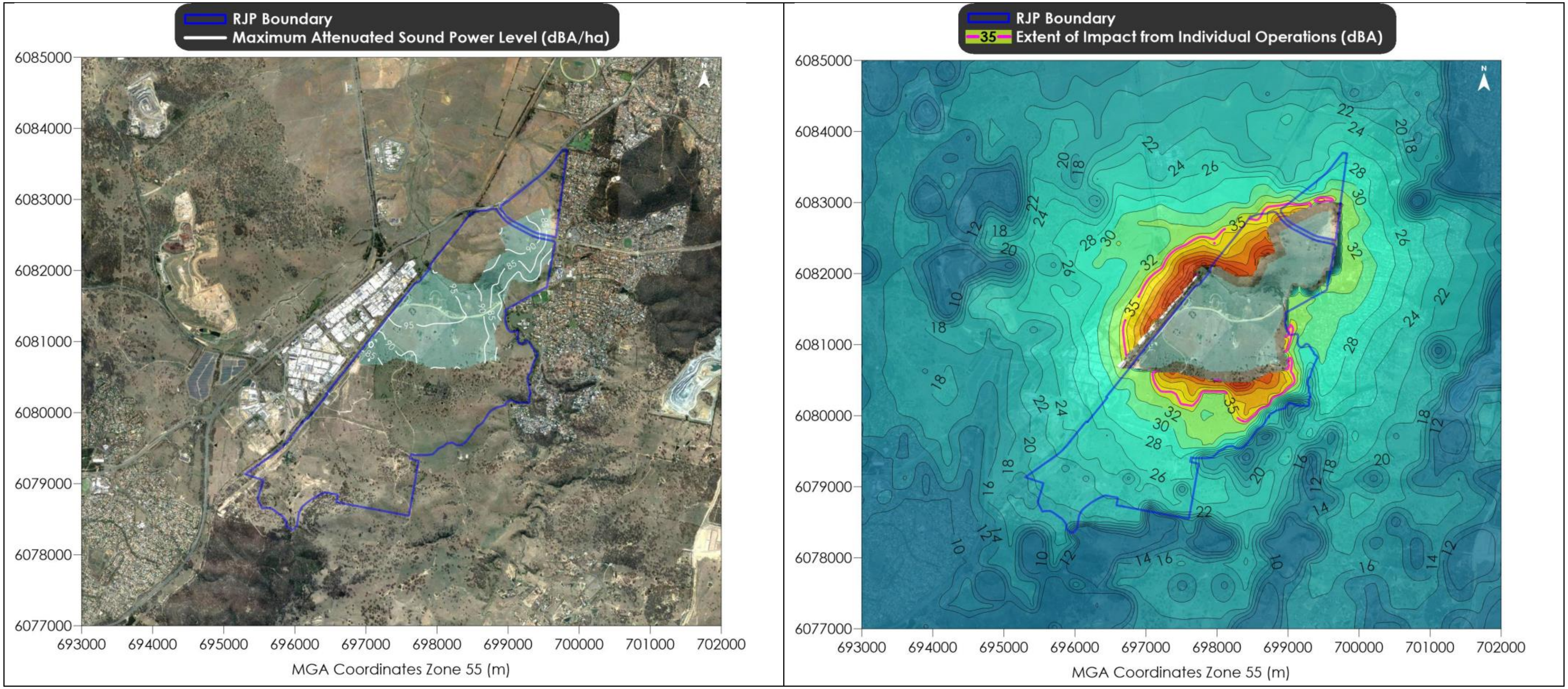

Figure 5-1: Source sound power level per Ha (left) and received sound pressure level (right) due to noise emissions from the RJP investigation area

5.3 Odour

As per the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**2016**) the most stringent 2 Odour Unit (OU) NSW criteria applicable to densely populated urban areas has been applied. A level of 1 OU can be described as the concentration of an odour at which it is detected.

The NSW odour goals are based on the risk of odour impact within the general population of a given area. Thus, in sparsely populated areas the criteria assume there is a lower risk that some individuals within the community would find the odour unacceptable, hence higher criteria apply. An odour criterion of 2 OU is used in this study at the assessed sensitive receptors.

Figure 5-2 presents the results for odour. The left hand side of the figure shows the odour emission rate per hectare for sources of odour in the RJP investigation area and the right hand side shows the recieved odour level outside of the RJP investigation area.

Referring to the left hand side of **Figure 5-2**, the contour lines within the RJP investigation area represent the maximum attenuated odour emission rate (OU.m^3/s/ha) (i.e., rate of release of odour that can leave the site, per second per hectare). The maximum attenuated odour emission rate for an industry can be estimated from odour measurements taken at the source of an existing/ similar facility and from odour measurements presented in available literature studies. This converts linearly to any lot's odour emission allowance. For example, if the lot is half a hectare, it can emit odour at half the rate of the contour line level passing through the middle of the lot. If the lot area is two hectares, it can emit double the contour line level.

Like noise, this odour emission rate allowance can be set as a property right for the lot, perhaps as part of any Section 10.7 Notice attached to the property. Referring to the right hand side of **Figure 5-2**, the pink line represents the 2 OU criteria boundary line. This is the area outside of which any receptors/sensitive receivers would not experience unacceptable odour levels above the criteria.

Also, like noise, should a lot be found to exceed its allocation, the degree of odour abatement needed would immediately be known and the normal (existing) process to ameliorate the odour can commence immediately (and be validated more swiftly and cheaply than via a process of measuring odour at the receiver can achieve). In this regard, the approach provides scope for a potential future odour trading scheme, which can minimise abatement costs. For example, rather than paying to further abate odour from its activity, the lot owner may be able to acquire some or all of the unused odour allocation from another lot. Whilst this is not proposed here, it is something that can potentially be set up if desired at a later time.

5.4 Odour mitigation options

As for any operation in NSW, as a minimum general or commonly used pollution controls are expected for industries in the industrial area which have potential to release air emissions.

The RJP investigation area and buffer is designed such that industries incorporating general levels of control should be able to operate within the industrial precinct without causing impacts. However, there are limitations, for example a facility that would have high levels of odour emissions may need to have extra odour mitigation if it chooses to locate close to the edge of the estate near receptors. Such a location is better suited to an operation which has odour emissions within the specified allowance as it is unlikely to need extra abatement.

The left hand side of **Figure 5-2** provides an allowance per hectare for potential odour emissions. This can be used as part of the approvals process where a proposed development with less emissions per hectare than the allowance for the proposed lot would be suitable. The figure also serves to help potential new industries to identify the more suitable lots where, depending on their emissions, the facility can reasonably expect to be able to operate without causing impacts (outside of the precinct boundary) or to require extra pollution controls.

General mitigation options for industries to manage odour emissions would vary depending on the nature of the source, and the effectiveness of potential mitigation options need to be considered in each case. Some examples of general odour mitigation options include:

- Mitigation at the source;
  - Handling of malodourous material within enclosed building or within a closed system. Aim to minimise exposure of material and prevent odour emissions into the environment.
  - Capture and ventilation of odour emissions at the source (e.g., hooding and extraction, negative pressure enclosures, etc.).
  - Exhaust odour emissions via a stack to allow for adequate dispersion.
  - Treatment of odour emissions before release (e.g., biofilter, carbon filter, thermal oxidiser, ozone reactors, etc.).
  - Regular cleaning of work space, clean up any spills.
  - Routine preventative maintenance on equipment.
  - Regular inspection of work place areas to identify odour.
  - Build continuous dense landscaping (bunds and vegetation) along odour source boundaries to assist in odour dispersion from the odour source. Provide guidance and training to on-site personnel to assist in identification of problematic odour sources at the site and taking proactive action.
  - Position the most odorous sources as far away as possible from receivers (the odour allowance will be higher there also).
  - Establish incident or complaint management system to assist with identifying odour sources and take preventative measures.
- Mitigation at the receiver may only provide small benefits but is appropriate for new dwellings outside of the receptor boundary;
  - Orientate buildings to provide adequate air flow around the building and design buildings to encourage air flow in a particular direction. This can be aided by block size and shapes and understanding of prevailing wind flows. Avoid construction of dead end courtyards or

long narrow spaces perpendicular to the prevailing winds where air can lay dormant and stagnate.

- Design buildings so living spaces do not face odorous sources and position any air conditioning and ventilation intakes away from the odour source.

The left hand side of **Figure 5-2** indicates relatively little constrain for odour generating activities. In general, such activities would be constrained if located in an area where the results indicate odour emissions at levels below approximately 3,000 to 4,000 OU/ha. The lower value may be an approspiate benchmark here, as major animal and livestock indusry (for which the higher value is suitable) is not anticipated.

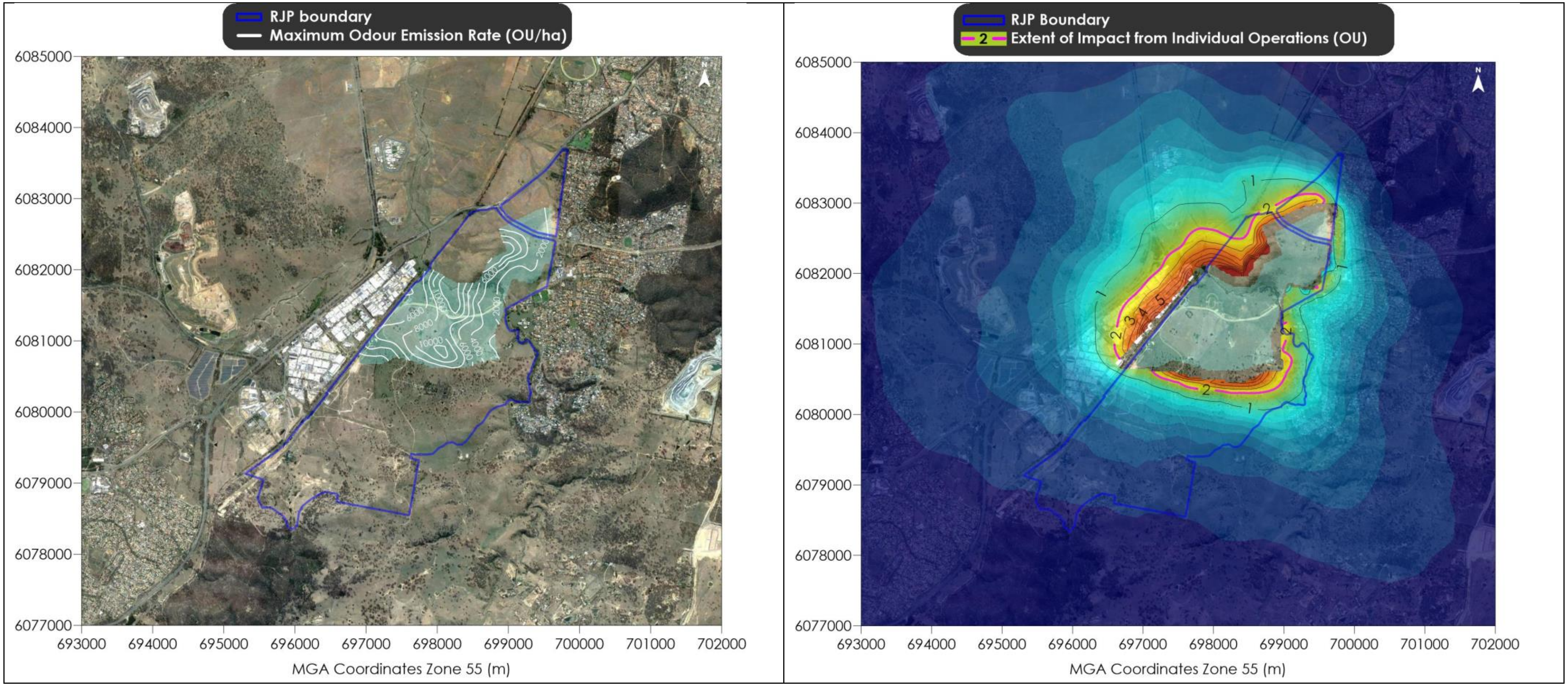

Figure 5-2: Source odour emissions rate per Ha (left) and received odour (right) due to odour emissions from the RJP investigation area

5.5 Air

For air emissions, it is not possible to ascribe a maximum quantity of emissions per hectare, given that there may be hundereds of different types of air emissions each with differing criteria averaging periods or locations for compliance.

For air, the approach taken is to accept that all air toxic emissions must be minimised to the maximum practicable extent, as set out in Section 7.2.1 of the NSW EPA Approved Methods (**2016**). Previous work identified that for fugitive air emissions, odour is the most limiting emission affecting potential compliance. As fugitive emissions will arise from area or volume sources, their zone of potential impact is considered as part of the odour assessment. Thus stack emissions are considered in more detail here.

Stacks have the potential to cause most impact at locations where the dispelled plume may reach the ground. For stacks, this is most likely to arise in elevated locations in the surrounding terrain but may also occur nearby due to plume down wash effects. As the earlier work has shown, it is prefereable to locate stacks in more elevated areas. This however is not mandatory as it is feasible for an applicant to simply specify a taller, higher velocity or higher temperature stack that has better dispersion and can perform equally well in a low lying area than a less highly performing stack in an elevated area.

Figure 5-3 shows the results for a generic source of air emissions represented by a typical industrial boiler stack. The figure shows no constraints beyond those for noise and odour.

The left side of **Figure 5-3** shows the concentration of NO_X emissions within the RJP investigation area which can be emitted from the stack (mg/m^3) that would meet an NO_2 concentration at receivers of 95 $\mu g/m^3$. When combined with an assumed background level of 85 $\mu g/m^3$ and a 100% conversion of NO_x to NO_2, this is well below the NSW EPA impact assessment criteiron for 1-hour averge NO_2 and a little above the proposed new NEPM limit for 1-hour averge NO_2. This concentration is also shown in the left hand side of the figure as the pink buffer line.

Note that there are two equally applicable limits/ criteria for a stack; the emissions concentration limits which apply to emissions in the stack (as set out in the POEO Clean Air Regulation); and, the ambient or ground level concentration limits which apply at a receptor (as set out in (**EPA, 2016**)). Hence where the level shown in the industrial area is greater than POEO Regulation limit for a stack, this means more emissions than are lawful for the stack would need to be emitted in order to exceed the criteria at a receptor. It does not mean that more than the lawful level of stack emissions are proposed in this industrial area.

The right hand side of **Figure 5-3** shows generalised guidance for locating industries with stacks. The general preferences shown cannot be used in planning documents other than for general guidance. The figures aim to assist applicants to identify locations within the industrial area where installing a stack will be less costly (preferred locations) and also guide approval bodies as to the level of scrutiny warranted for applications with a stack. For example, a stack with higher specifications may be needed in the zone between the “preferred” and “no stacks preferred” areas for stacks and a high level of regulatory scrutiny would be needed for approval of stack applications in the “no stacks preferred” areas.

5.6 Air mitigation options

As for any operation in NSW, as a minimum, general or commonly used pollution controls and mitigation is expected for industries in the industrial area which have potential to release air emissions.

The RJP investigation area and buffer is designed such that industries incorporating general levels of control should be able to operate within the industrial area without causing impacts. But there are limitations, for example a facility with high levels of air emissions may need to have extra pollution controls (and not just a stack) as the locality is better suited to an operation that does not require a stack to manage pollution.

The right hand side of **Figure 5-3** provides a guide for new industries to help identify the more suitable lots where, depending on the type of industry and emissions, the facility can reasonably expect to be able to operate without causing impacts (outside of the precinct boundary) or requiring extra pollution controls.

Specific stack parameters will be tailored to the requirements of the industry it services and should be designed with consideration of good engineering practice.

General mitigation options for industries to manage air emissions from stacks include:

- Mitigation at the source.
- Increase stack height to allow for additional dilution.
- Increase stack velocity to promote dispersion.
- Increase stack temperature to promote dispersion of exhaust gases.
- Treatment of air emissions before release (e.g., carbon filter, thermal oxidiser, Bag filter etc.).
- Maintain equipment – regularly inspect and maintain equipment to ensure it is in good working order.

The left hand side of **Figure 5-3** indicates that essentially none of the RJP area is ideal for significant industrial stacks. This arises due to the existance of many areas of residential land in elevated, complex terrain, essentially looking down onto the RJP areas. Stacks tend to have their greatest impacts in the surrounding elevated terrain. A further constraint is the Canberra Airport OLS, the issue being that to prevent impact at receptors, a higher stack, with a higher projection height of the plume is needed, but the OLS would prevent this occuring for a significant stack, especially in the northern parts of the RJP.

Overall, the results indicate the locality is not suitable for traditional large stacks associated with heavy industry, and this type of industry has not been proposed in the Master Plan. General industry, which may have stacks, can operate but it warrants additional care in the assessment and approvals process. For example, industries that propose stacks must ensure their assessment has adequately considered the relatively distant residential areas in the surrounding elevated terrain, and that a high quality terrain and meterological model is used to determine any potential impacts.

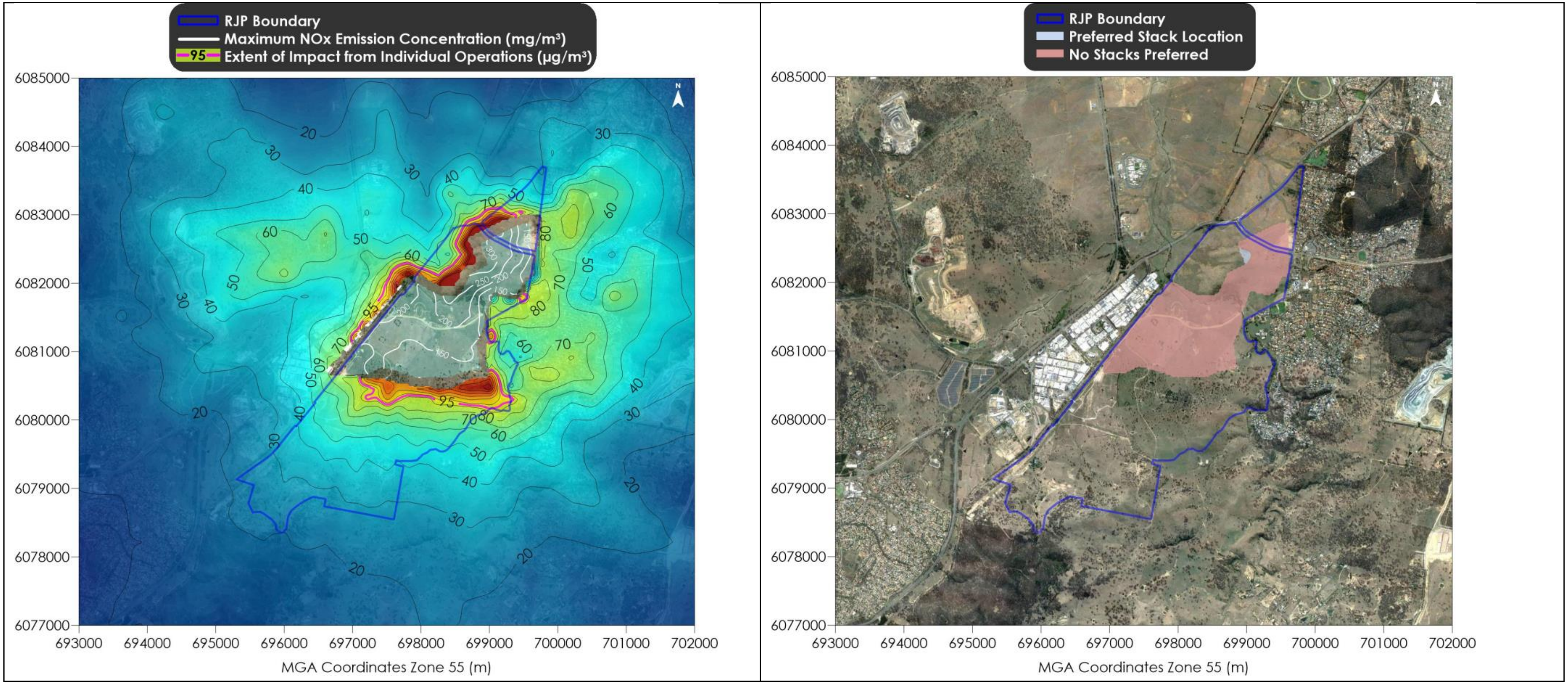

Figure 5-3: Example of Air emissions rate per stack and received air pollutant concentrations due to NO_x emissions from the RJP investigation area (left) and generalised guidance for locating industries with stacks within the RJP investigation area (right)

6 CONCLUSIONS AND RECOMMENDATIONS

The modelling indicates that the general Master Plan layout is relatively well suited to the situation.

The key areas of potential constraint are those shaded in red in **Figure 4-1** and **Figure 4-2**, both internally and externally to the RJP investigation area. These figures identify the areas within the RJP investigation area where there would need to be relatively strict controls on air, odour or noise emissions from industry, and where (without such mitigation) there may be impacts at receptor areas outside of the RJP investigation area or in the R1 zone within the RJP. Noise, and especially night-time noise is the most limiting factor to consider, and close attention should be given to the results in **Figure 4-2** when finalising the Master Plan.

The figures in **Section 5** quantify the degree of mitigation needed within the RJP investigation area, or in other words the emissions per unit of land that may potentially be emitted without causing impacts outside of the pink criteria line (noting that presently there are no sensitive receptors within the pink line). These figures are useful to evaluate the likely buffer around the RJP needed to prevent land use conflicts if fully developing the RJP (i.e., the pink line). They also assist to identify the relative scale of potential emissions from any part of the RJP area; these are the white lines within the RJP area, or the preferred stack zones.

The white lines indicate that the parts of the RJP where the greatest emissions may be released without impact appear to be similar for odour and noise (i.e., for noise this is the north-western "corner" of the RJP where there is a sports field). No locations are ideal for stack sources, but the northernmost areas are perhaps most constrained, and the better areas are more centrally located within the RJP (away from nearby elevated terrain). Overall, the results show that large areas of low sloping land are suitable for industrial use, and importantly this covers most of the existing industries (but not all, see further below).

It is important to note that the modelling assumes the criteria are to be met at all sensitive receptors, (i.e., the pink criteria line is always adjacent to any potentially impacted existing or likely future receptor). In some cases, it may not be feasible to meet criteria at the existing receptor. For example, by looking at the red areas inside the RJP per the figures in **Section 4** or the relative emissions values per the white lines on the figures in **Section 5**, we can see that the results are heavily influenced by the close proximity of receptors to the east and also in South Tralee.

The close proximity of these receptors to the RJP land limits the scale of air but especially noise emissions that can be emitted within the RJP. The results indicate significant noise constraints for the central-eastern parts of the RJP. From a noise perspective, it is not ideal that there is already an industrial area under construction in this vicinity, however some suggestions to manage potential impacts are provided in Section 5.2.

Adding new receptors within the pink criteria line shown in the figures would further limit the capacity of industry to operate in the RJP (or conversely put receptors in areas of potential impact from industry). The late developer submission to add a wedge of residential land in this area, between the existing and proposed industrial uses, cannot be supported in any way.

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Appendix A
Selection of meteorological year

Selection of meteorological year

A statistical analysis of the latest six contiguous years of meteorological data from the nearest BoM weather station with suitable available data, Tuggeranong AWS weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2015 to 2020 was analysed against the available measured wind speed, temperature and relative humidity data. The analysis indicates that 2020 dataset is closest to the mean for wind speed and temperature and 2018 is closest to long term relative humidity.

On the basis of a score weighting analysis, the 2018 year was found to be most representative.

Table A-1: Statistical analysis results for Tuggeranong AWS

Year	Wind speed	Temperature	Relative humidity	Score
2015	0.3	0.9	3.3	4.9
2016	0.3	0.8	3.3	4.7
2017	0.4	0.9	3.3	5.0
2018	0.3	0.8	3.3	4.7
2019	0.3	1.2	4.8	6.5
2020	0.3	0.7	4.2	5.5

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2018 year compared with the mean of the 2015 to 2020 data set. The 2018 year data appear to be reasonably well aligned with the mean data.

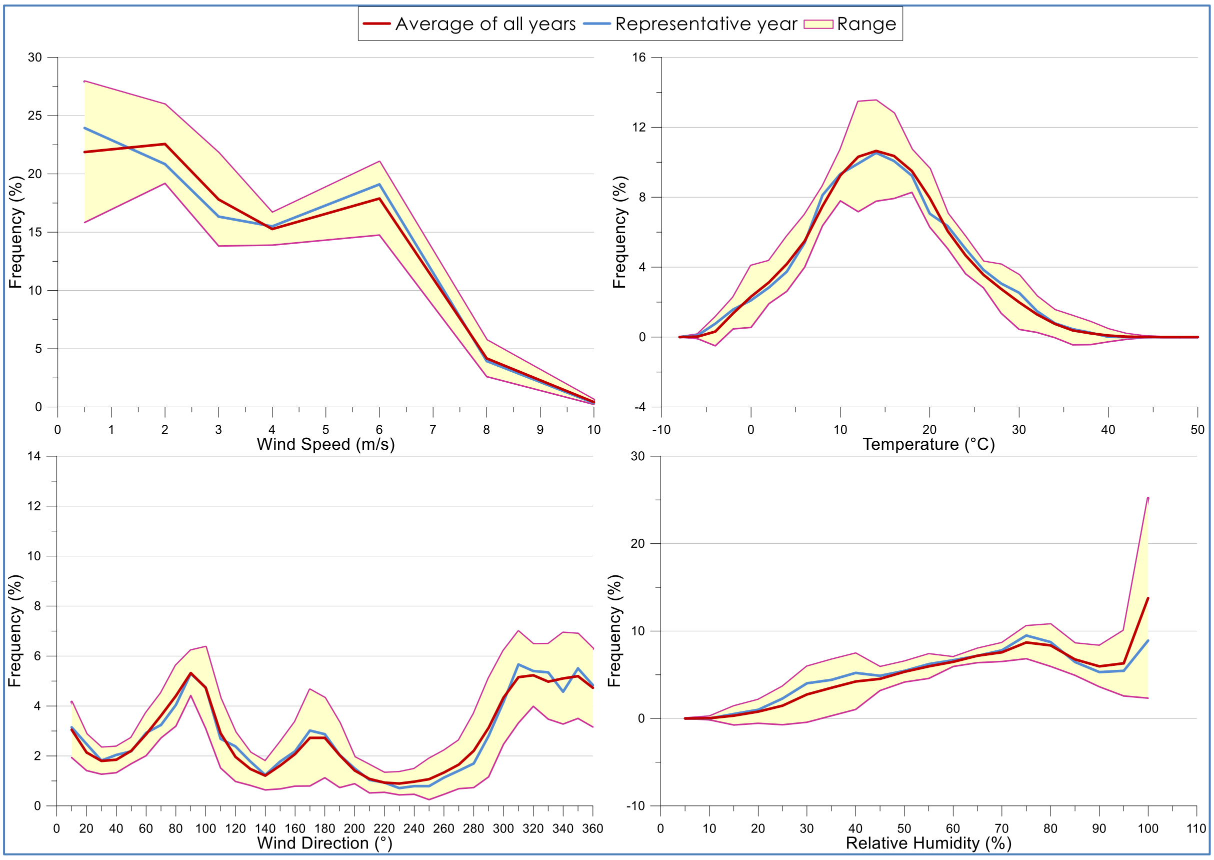

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

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