Wollert Recycled Water Treatment Plant

VPA Submission- Siting and Risk Assessment

IS0803QY-DM-RP-0001 | A

11 September 2020

Yarra Valley Water

N/A

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	11/09/2020	Issue for Review	D. Jarred M. Hall	L. Fuda T. Freeman	M. Honeyman	M. Harding

4. Treatment Facility Scoping

Key assumptions and inputs that have been used to develop the preliminary site footprint and process unit layout for odour modelling purposes are summarised below. For further details regarding the treatment facility scoping, refer Appendix C.

4.1 Treatment Process Selection

Design that will determine the ultimate type of treatment system used, and the number and size of individual elements of the treatment plant has not yet been completed.

A preliminary design following typical practice used at other recent YVW sewage treatment and recycled water production facilities has been completed and is considered to provide the most reasonable practicable estimate of site footprint and associated inputs to odour modelling. The estimate has included primary settlement tanks and tertiary treatment with secondary clarifiers as the basis of footprint as a worse case. It is expected that treatment unit configurations that improve energy / resource recovery opportunities in line with latest government / water industry strategies may be included in future design phases of the project resulting in a reduced odour footprint. This is consistent with recommendations of the Kalkallo STP Resource Recovery Options Investigation report. The conservatism of the site layout minimises the possibility of underestimating the odour emission contours, as odour emission rates from the process units are typically proportional to the open surface area.

The conventional treatment process employed includes the following primary assets:

- Influent pumping station and inlet works;
- Primary Settlement Tanks;
- Activated sludge reactors ;
- Tertiary treatment;
- UV disinfection;
- A structure to house further treatment assets for producing Class A NDW including micro-strainers, ultrafiltration (UF) membranes, and further disinfection;
- Ancillary and waste management assets including chemical storage facility, sludge dewatering facility and amenities to accommodate onsite operators.

Water storage basins are anticipated to be installed at the Langley Park Drive site, on land owned by YVW, so no storage basins are considered for the Golina site.

Smaller footprint processes are available, but these would increase the cost to the community as the capital and/ or operating cost of such facilities typically exceed the typical plant considered in more specialised or more energy intensive equipment.

4.2 Facility capacity

As discussed in Section 1.1, the original proposed NDW production capacity of the Wollert RWTP was 45 Ml/d in 2011. This demand estimate included provision to supply a gas production facility that was initially identified for construction nearby, and was anticipated to have a significant NDW demand. This facility is no longer being constructed at this location, so the Wollert RWTP production capacity has been revised to meet local PSP development demands, resulting in an estimated ultimate capacity of 20 Ml/d NDW production. The capacity of the Wollert RWTP is not fully defined at this stage, as it will be a function of the Aurora RWTP capacity (being developed in an ongoing project) and eventual development in the NGC, but it is anticipated that 20 Ml/d NDW production is the maximum size that would be developed at this site to provide the optimum servicing of the northern areas with NDW.

The facility will operate by extracting sufficient untreated wastewater from the adjacent Amaroo Main Sewer (i.e. sewer mining, rather than a conventional 'end of pipe' treatment plant). It has been assumed that an end-to-end (i.e. inlet of sewage through to production of NDW) recovery rate of 70% can be achieved by the facility. This is a typical end-to-end recovery rate for conventional recycled water treatment plants. For a 20 Ml/d NDW production rate a sewage influent flowrate of approximately 28.5 Ml/d is therefore required.

4.3 Treatment Footprint Siting

Key factors that have defined the proposed site footprint are shown on Figure 2.3 and listed below:

- Fly rock buffer on the northern boundary;
- Conservation Area 28 on the southern boundary;
- 50m wide vegetation screen between the Conservation Area 28 boundary and the Wollert RWTP.

The primary space available for the treatment process units is in the eastern corner. A key sensitive receptor near to this location is the future residences east of Woody Hill quarry, as identified from the Shenstone PSP. As such, their location is a key point of reference for odour modelling and site layout development. We have conservatively located the assets that are most likely to be high odour-emitting assets in the eastern end of the site, closer to this sensitive receptor. This was done to reduce the risk that adjustments to the layout during design development would increase the risk profile compared to what has been assessed for this report.

The site footprint developed for preliminary footprint sizing and odour modelling is shown in Figure 4.1.

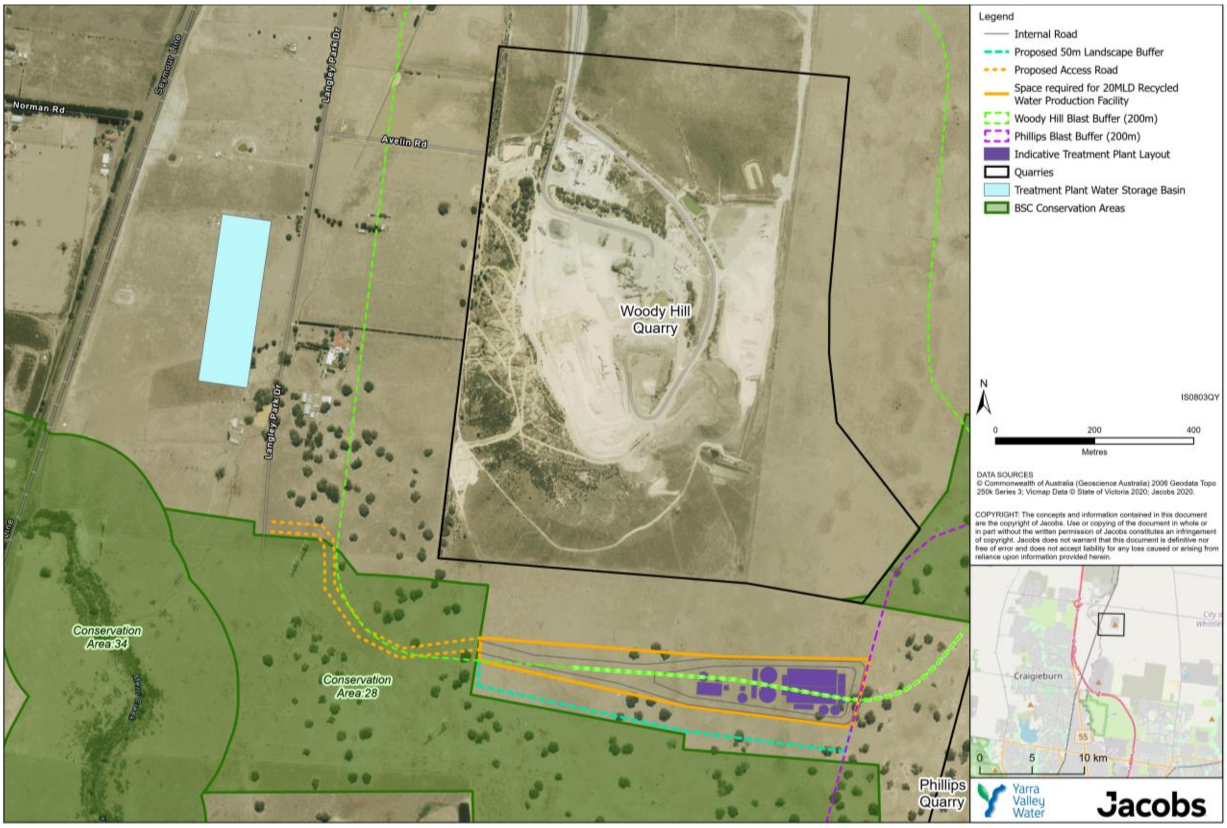

Figure 4.1: Site layout with a primary focus of reducing impact on identified site constraints.

The site footprint is within the Woody Hill fly rock buffer, which was a primary trigger for pursuing the engagement with Barro Group to fully understand the risk posed by encroaching on the fly rock buffer. Refer Section 3.2 for detail.

Assets which are less likely to impact on visual amenity have been located towards the Golina residence as this reduces visual impact as well as odour risk to the private property.

The site layout is not considered a preferable arrangement, with poor land use when considering the footprint required relative to the NDW production capacity of the RWTP, but based on the site constraints it is a suitable arrangement to consider at this stage of design

5. Odour Assessment

5.1 Objectives and General Approach

The objective of the odour assessment was to assess and compare the potential odour impact of the proposed RWTP for the different site location options and configurations. The outputs of the work are used to inform the high level plant site risk assessment.

The odour impact assessment was undertaken in accordance with the Victorian Government State Environment Protection Policy (Air Quality Management) [SEPP (AQM)]. This policy sets out methods of assessing air quality impacts from industrial air emission sources using atmospheric dispersion modelling. Schedule A of SEPP (AQM) specifies a design criterion for general odour, and explains (Schedule A, Note 8) that "*emissions of mixed odorous substances, such as those from sewage treatment farms, rendering plants and intensive animal industries may be offensive and therefore need to be minimised and controlled to ensure that beneficial uses of the environment are protected. General odour is defined in SEPP (AQM) as an unclassified air quality indicator of local amenity and aesthetic enjoyment of the air environment. The design criteria for new sources of general odour is the odour detection threshold (1 OU) and should be applied at and beyond the boundary of a premises*." In addition, Clause 19 requires the generator of any new source of emissions to apply best practice to the management of their emissions.

In the Wollert RWTP odour assessment, an iterative process has been undertaken whereby different site layout options and extents of odour mitigation have been applied and modelled to arrive at solutions which minimise impact to surrounding sensitive receptors sites and other land users as far as practicable. Specifically, this has included:

***Site selection* –** The assessment was initially carried out for both the Langley Park Drive site and the Golina site options; refer Section 2 for details of the site options considered. Due to the higher odour impact predicted for the Langley Park Drive site, the use of the Golina site became the focus of the current assessment. Comparison of odour impact for the Langley Park Drive site and the Golina site is provided in the 'Wollert RWTP Siting Risk Assessment Report', Jacobs, 2020.

***Plant production capacities* –** The investigation included review of odour impact for plants of different production capacities.

***Site layout and configuration* –** Adjustments were made to the Golina site layout, refer Section 6.1, to minimise potential impact to the Golina residence while also reducing, as far as practicable, odour impact at the adjacent industrial sites.

***Odour emission rate variation* –** The odour assessment incorporated a review of different odour emission rates which may occur from the plant process units to understand the potential sensitivity of emissions on odour impact and to assist in the overall risk assessment process.

***Odour mitigation options* –** Different odour mitigation scenarios were applied in the modelling assessment to explore sensitivities and the impact of mitigation options.

These activities assisted in evaluating practical solutions for the siting and high level design of the proposed RWTP within the site boundary constraints.

5.2 Methodology

Air dispersion modelling was undertaken with AERMOD software (v19191), EPA Victoria's current approved regulatory dispersion model, and in accordance with EPA Victoria's current guidelines[1].

Modelling was carried out using 1 year, i.e. 8760 hours, of meteorological data, specific to the Wollert site. Various operating scenarios were modelled, including odour emission scenarios representing 'normal' and 'peak' odour emissions; refer Section 5.3, and different odour mitigation options. The intent of the review of different options was to incorporate best practice odour mitigation at this high level design stage.

The model-predicted odour impact was compared with the odour assessment criteria (refer Section 5.2.3) as part of the risk assessment.

5.2.1 Model settings

As per the requirements in SEPP (AQM), modelling results for a 3-minute average were extracted from the model outputs at each receptor using the 9th highest value (i.e. the 99.9th percentile for an annual hourly meteorological data set).

Key model settings are provided in Table 5-1.

Table 5-1: Key modelling inputs and settings

Parameter	Model setting / input
AERMOD software	AERMOD v 19191
Meteorological data files	Upper and surface files generated, specific to site, using Melbourne Airport BoM observations data (see Section 5.2.2 for methodology). Model year 2014 – 8760 hours modelled.
Grid receptors	8 km x 8 km model domain Horizontal grid spacing 100 m, with nested grid (for areas within 1 km of the production plant boundary) of 50 m 81 x 81 grid points (6,561 points)
Terrain effects	Included – see Section 5.2.2. Used 30 m resolution data for the model region.
Building wake effects	Included for each model scenario. Involved the representation of the sludge dewatering building for both sites. This was expected to be the tallest building on site and other shorter infrastructure were not expected to have any significant influence on the plume dispersion pattern. For the Golina site, a 50 metre wide and 6 metre high berm along the southern and western perimeter of the site was also incorporated for selected models to test potential impact.
Outputs	1h average ground level concentrations for odour. Peak-to-Mean Ratio [Note 1] method used to convert 1h average results to 3 minute average results as required by the SEPP (AQM).
Low wind options	Low wind option activated – for improved handling of low wind and stable conditions which are important for odour dispersion modelling. AERMOD default parameters were applied.

[1] Guidance notes for using the regulatory air pollution model AERMOD in Victoria, EPA Victoria, Publication 1551, Revision 6, February 2015

Parameter	Model setting / input
Source characterisation	Area sources represented as volume sources in the model, per EPA Victoria advice

Notes

1. To compare the model results to the SEPP (AQM) design criteria, it is necessary to convert the predicted hour average results to 3 minute average results for some pollutants, including odour. This is done using the recommended peak to mean ratio method set out by EPA Victoria[2].

5.2.2 Meteorological Modelling

Methodology

The wind data used was sourced from the Melbourne Airport observation site operated by Bureau of Meteorology (BoM), with wind patterns summarised by the wind rose in Figure 5.1. The wind direction is dominant in the northerly and southerly directions, with a high frequency of low wind speeds, i.e. with speed less than 2 m/s, from the north and west (refer inset).

The Melbourne Airport BoM is the nearest meteorological station to the Wollert site which collects hourly wind data suitable for modelling. Due to the similar wider scale topography at the BoM station and at Wollert, the weather patterns at each site are expected to be similar. The BoM station is approximately 17 km from Wollert, thereby satisfying the EPA's guidelines[3] for the use of directly measured parameters from observations within a 25 km radius of the application site. An alternative source of meteorological data was the dataset for 2003-04 generated by the EPA specifically for Craigieburn, adjacent the Wollert site. The Melbourne Airport BoM data was preferred over the Craigieburn 2003-04 dataset as there was a complete year of data (as opposed to the Craigieburn dataset which spanned only 9 months), more recent wind data was available for the Melbourne BoM station, and the BoM data was sourced from a standard mast height (10 metres), which wasn't the case for the Craigieburn dataset. The two datasets were analysed and the Melbourne Airport BoM data was found to compare well with the EPA's Craigieburn dataset.

Hourly meteorological data observations from the Melbourne Airport BoM for years 2012 to 2018, inclusive, were reviewed for the purposes of model year selection. Of these years, 2014, 2015 and 2017 were identified as representing the 'worst case' in terms of odour dispersion, with the frequency of low wind speeds being higher than the average for the 2012 – 2018 period. Year 2014 was selected for modelling, for consistency with recent modelling for the nearby Craigieburn Hub facility.

As Melbourne Airport BoM data represent a comprehensive suite of meteorological observations, both for the surface and upper air, the AERMET files for Wollert were able to be compiled directly from observed data without the need to use an intermediate prognostic model. The prognostic model provides a simulation of surface and upper air meteorology by the use of terrain, vegetation, soil type and synoptic-scale meteorological information. Although it is a very useful tool when there are no observation data available, it is a model simulation and therefore introduces uncertainty and is a less robust approach compared to the use of observations. As set out in the EPA guidelines[3], the use of meteorological observations, where available and representative of the site to be modelled, is the preferred approach.

[2] Guidance notes for using the regulatory air pollution model AERMOD in Victoria, EPA Victoria, Publication 1551, Revision 6, February 2015
[3] Guidelines for input meteorological data for AERMOD, EPA Victoria, Publication 1550, Revision 3, September 2014

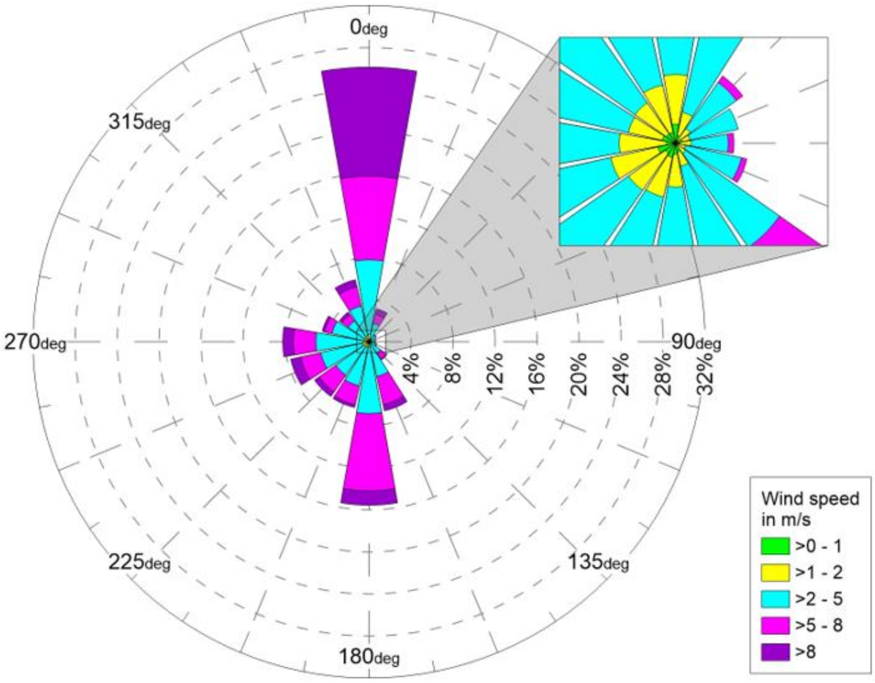

Figure 5.1: Melbourne Airport 2014, hourly average wind records.

Topography

The surrounding terrain (Figure 5.2) is relatively flat with the exception of the quarry directly north of the Golina site, which includes a small hill. The area to the south is at a lower elevation, as well as the creek to the southwest which forms a depression in the terrain. The red outlines in Figure 5.2 depict the site boundaries for the Golina site, to the south of the quarry. The Langley Park Drive site to the west of the quarry, which was originally considered and subsequently dismissed as a potential site option, is also shown (red outline). The blue boundary represents the proposed Class B lagoon basin which would be part of the RWTP.

The current land use is mostly rural grasslands with some isolated residential premises nearby, with the exception of the nearby quarry which is an industrial premise.

The land use data specific to the Wollert site were incorporated in the meteorological datasets generated for the modelling. Terrain data was included in the AERMOD model for the modelling domain, at 30 metre resolution.

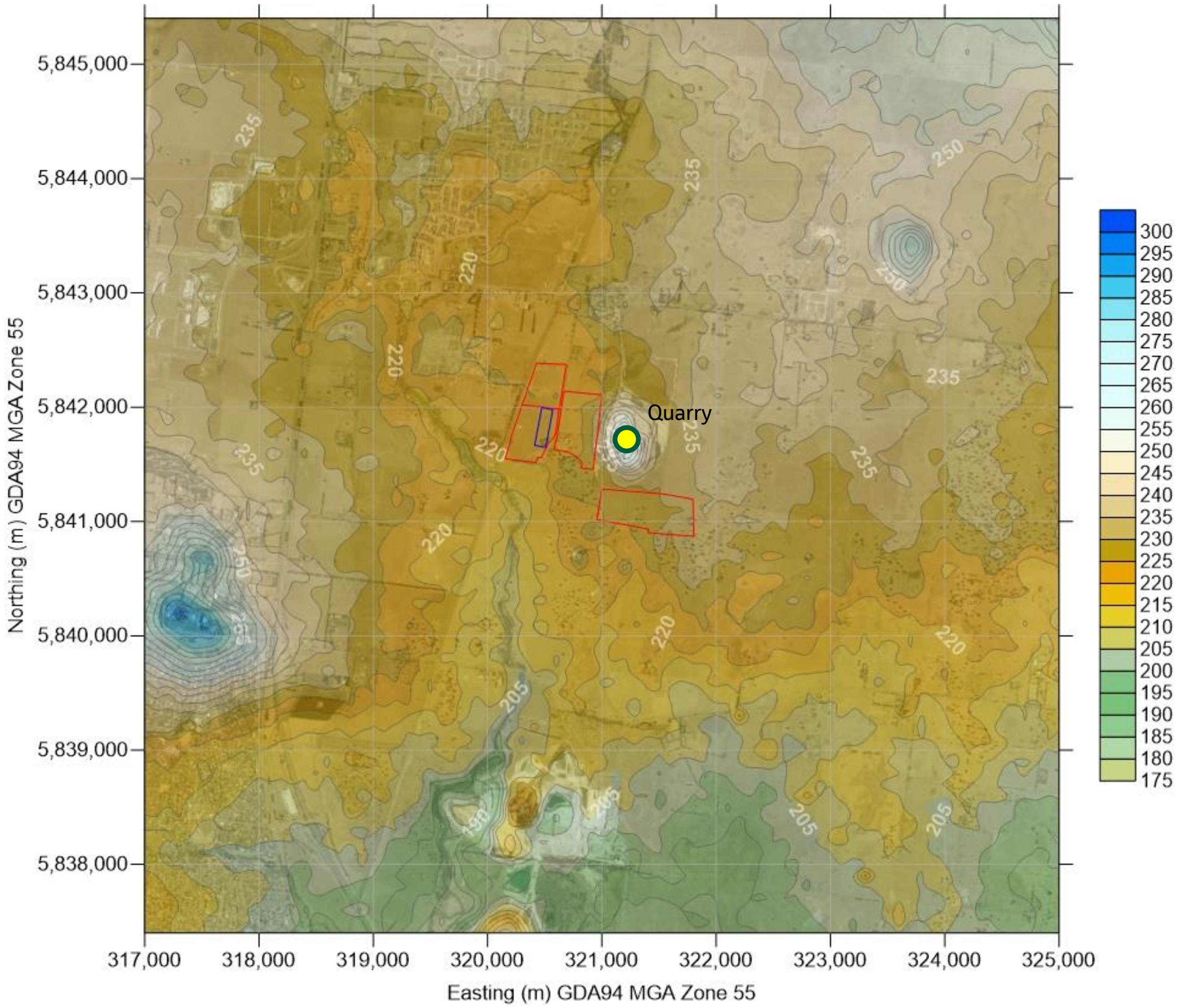

Figure 5.2: Overview of the region's topography. Red outlines - site boundaries for the Langley Park Drive site (areas to the west of the quarry) and the Golina site (to the south of the quarry). Blue outlines - Class B lagoon basin which is common to both site options. Quarry location indicated by yellow circle.

5.2.3 Odour Assessment Criteria

This section provides some qualitative explanation of the odour dispersion modelling quantitative outputs, including context of how odour units relate to community impact odour and state-to-state use of odour units in odour impact assessments.

Under Schedule A of the SEPP (AQM), the design criteria for ground level concentrations (3-minute averaging period, 99.9th percentile), is:

General odour (unclassified indicator): 1 OU (based on amenity)

For new or modified sources of odorous emissions, Schedule C specifies that the design criterion based on odour applies at and beyond the boundary of a premise. It also specifies that the 99.9th percentile odour concentration is to be used for comparison against the criteria. However, the Explanatory Notes for Schedule A of the SEPP (AQM) also indicate that "*in situations where the design criteria cannot be met, a risk assessment taking account of site-specific circumstances and demonstrating that the beneficial uses of the environment are protected will be considered*".

The 1 OU criteria specified by the SEPP (AQM) represents the threshold of odour as detected by the human nose – 1 OU is defined as the odour concentration at which half of an olfactometry panel is able to detect an odour sample. Although this criterion has been used for this study to assess compliance with the SEPP (AQM), it is acknowledged that it is a strict ambient air quality standard that can be difficult to meet, and in many cases is more stringent than is actually required to avoid offensive odours occurring beyond the site boundary.

In practice, the threshold for detection of odour above background levels which may result in an odour complaint is higher than the SEPP 1 OU criterion and typically ranges from 2 – 10 OU. For example, the Queensland government (DEHP) adopts an annoyance threshold of 5 OU. The South East Water utility adopts 4 OU as the odour annoyance threshold. This latter threshold was based on a study which compared modelling results and ambient odour observations.

The typical human reaction to different odour concentrations is provided in Table 5-2. There is normally a variation within a population for the odour concentration which is considered to be a nuisance. The nuisance odour concentration (typically between 2 and 10 OU) will depend on a variety of factors including characteristics of the odour source, frequency of occurrence, population sensitivity, duration of exposure, etc.

Table 5-2: Typical human reaction to odours

Odour Concentration (OU)	Description	Human Reaction
1 (Human Threshold)	The lowest concentration at which the average noses can detect the odour.	Human nose can determine a difference from normal background air in a lab. The odour has no character, just noticeably different
3 - 5	Slightly noticeable above background for some people	Human nose may recognise the character if previously experienced at higher strengths. The odour may cause slight discomfort to some individuals, but typically it’s not alarming.
7 – 10	The odour is weak but distinct above background air	The human nose can recognise the character, regardless if it has been previously detected or not (may cause a nuisance if it occurs frequently).
20	Odour is distinct above background levels	The human nose can recognise the character and be offended by it (may cause a nuisance odour reaction at short durations).
50	The odour is very noticeable above background levels	The human nose can easily determine the source and can result in a nuisance odour reaction with most individuals

The odour concentration representing the ‘nuisance level’ which is incorporated into the odour assessment criteria, and the way it is applied, varies for environmental regulators from state to state. Various factors that are incorporated into odour assessment criteria across Australia include the following:

- In some states, different criteria are applied depending on the population potentially affected by the emissions, with higher acceptable concentrations assigned to areas with low population density (e.g. rural area with isolated residences).

- Modelling is typically carried out using hourly time-steps whereas odour nuisance is measured with respect to nose response times. As such, the nuisance odour concentration and/or the modelling results need to be scaled; e.g. using peak-to-mean factors to estimate different averaging times, so that they can be compared using a common time basis. These peak-to-mean criteria and "peak" averaging times are different from state to state.
- Different scaling factors can also be applied depending on the odour source type – e.g. point source, area source or volume source.
- Statistical filtering is applied to the results to remove the extreme values generated during the modelling from the reported results. This is known as taking a certain upper "percentile" of model results, e.g. 99.9th, 99.5th, or 99.0th percentile.
- Furthermore, the assessment criteria can be applied at different locations, typically at and beyond the site boundary, or at the nearest sensitive receptor sites.

Australian states have applied these factors in different ways, resulting in variations in the odour assessment criteria. A summary of the odour criteria for various states in Australia are summarised in Table 5-3.

Table 5-3: Odour assessment criteria summary.

State	Odour concentration assessment criteria	Averaging time	Filtering statistic
South Australia	2 OU, for populations of 2000 people or more, at closest sensitive receptor 10 OU, for single residence (fewer than 12), at closest sensitive receptor Note 1	3 minutes	99.9th
Queensland	0.5 OU for wake-free stacks, at closest sensitive receptor 2.5 OU for wake-affected stacks, at closest sensitive receptor	1 hour	99.5th
Victoria	1 OU, at and beyond site boundary	3 minutes	99.9th
New South Wales	2 OU, for urban areas, nearest sensitive receptor 7 OU, for rural residences, nearest sensitive receptor Note 1	1 second Note 4	99.0th
Tasmania	2 OU, at and beyond site boundary	1 hour	99.5th Note 2

Notes:

1. Where the odour concentration criteria are population dependent, only the highest and lowest odour concentrations of the range are shown.
2. The Tasmania assessment guidelines require maximum results, i.e. 100th percentile, at site boundary and beyond if good quality meteorological and/or emissions data are not available.

3. 'Wake-free stacks' refers to a stack that is sufficiently higher than any nearby building such that the stack emission plume dispersion is not affected by the building. In contrast, a 'wake-affected stack' is stack affected by the building in this scenario.

4. Tables of conversion factors are provided for converting 1-hour average from model into a peak concentration. These conversion factors vary with source type, and distance from the source.

Due to the current surrounding land use constraints on the extent of the NDW Production Plant site boundary, compliance with the 1 OU criterion beyond the site boundary is not expected to be practically achievable. The SEPP (AQM) allows for alternate approaches to be used in such cases to assess the risk of offensive odour impacts.

In this case, the approach was taken to use dispersion modelling to assess different emission scenarios and minimise the odour impact as far as practicable. As discussed in Section 5.1, this has involved the incorporation of best practice odour mitigation design (at a high level) and assessment of potential odour emission rate scenarios, with the overriding objective of minimising the potential for environmental harm, specifically odour nuisance, beyond the site boundary. Residual odour concentrations predicted to occur beyond the site boundary were then assessed for the risk of offensive odour occurring.

Determining a more appropriate nuisance odour level to apply to the assessment is complex and site-specific. Ideally, comparison of the odour dispersion model results against odour observations can be carried out to "benchmark" the model results and assist with assigning the representative nuisance odour level criterion. As the Wollert STP has not yet been built, field odour observations cannot be carried out. Instead, a 'mid-point' of the conservative range of 3 – 5 OU (slightly noticeable above background levels for some people; Table 5-3), i.e. 4 OU, was selected to represent the level at which nuisance odour impact may occur. This criterion was applied when assessing scenarios with the more conservative odour emission rates.

In summary, the odour criteria used in the modelling assessment were:

- Initially, applied 1 OU and 99.9th percentile for 'average' expected odour emission rates.

- As the odour footprint for the 'average' odour emissions did not meet this criteria (i.e. the 1 OU contour extended beyond site boundary) due to the constrained site boundary, a risk assessment was carried out for the scenarios with 'peak' odour emission rates; refer Section 5.3 for emissions details. For these scenarios, the 4 OU criterion was applied to assess the potential for odour nuisance complaints. The 99.9th percentile results were assessed. The 4 OU criterion was based on the level at which odours conservatively become recognisable and therefore might cause an offense for some sensitive people (around 3 – 5 OU).

Both the average and peak odour emission scenarios applied to 'normal' expected operation of the plant, with the peak emission rates representing the near-maximum potential odour emissions and average rates representing typical values expected, based on other similar applications. Upset conditions at the plant were not assessed due to the high levels of uncertainty in the generation of emissions scenarios for plant upset conditions for a plant that has not yet been built or even designed in detail.

5.2.4 Sensitive Receptors

The key sensitive receptor in proximity to the Golina site is the Golina Holdings residence, located south west of the proposed production plant site. This site was the focus for assessment of the model outputs to minimise potential odour nuisance impact.

In addition, the work included assessment of the model outputs at a receptor site near (within approximately 100 metres of) the eastern site boundary of the production plant and within the adjoining proposed industrial quarry development site. Although not a sensitive receptor site, this location was selected for modelling assessment as it was identified as a potential area at which quarry facilities and/or activities may be located in the future. This is preliminary only and has not been confirmed by Barro.

5.3 Model Scenarios and Emissions

Odour inventories were generated for six scenarios, A to F, involving combinations of the odour emission rate scenarios and extent of odour mitigation applied.

The SEPP (AQM) states "estimates for emission rates must be based on the 'worst case' scenario during normal operations, with any uncertainty in the estimates erring on the side of conservatism". As only high level layout options for the plant have been generated at this stage, there is uncertainty regarding the extent of odour emissions from the site. As a result, both 'average' and 'peak' odour emission rate scenarios were incorporated in the study to represent potential design and operating scenarios. Refer Section 5.3.1 for detail.

A summary of the model scenarios is provided in Table 5-4. Case A through to Case E were modelled for both the Langley Park Drive site and the initial production plant configuration at Golina. Following the optimisation of the plant layout at Golina (refer Section 6.1), modelling was carried out for Case B, Case C, Case E and Case F. These were considered to be most important scenarios in informing the risk assessment for the sensitive receptor location and at the adjacent proposed industrial facility.

Table 5-4: Summary of odour model scenarios and emission rates for 20 Ml/d plant

Scenario	Odour emission rate scenario	Level of odour mitigation	Odour Emission Rates (OU.m^3/sec)	
			Ground sources	Point sources
Case A	Average	Limited	9,002	1,257
Case B	Average	Mid-level	4,403	7,599
Case C	Average	High	3,291	8,149
Case D	Peak	Limited	18,027	1,257
Case E	Peak	Mid-level	11,207	7,599
Case F	Peak	High	8,436	8,149

5.3.1 Ground source odour emissions

The 'peak' odour emission rates for the ground sources were sourced from the 95th percentile data for the respective odour sources from Jacobs' odour database which is a collation of odour sampling measurements taken at various wastewater treatment facilities.

The 'average' odour emission rates for the ground sources were sourced from Jacobs' odour database and are the calculated average SOERs from the available data for each odour source.

For some applications, refinement of the calculated separation distances provided in the EPA guidelines (publication no. 1518, March 2013, see Section 5.4.3) for STPs are carried out by generating odour inventories for, and then modelling, different plant upset scenarios, e.g. algae in lagoons, failure of aerators, etc. As the current project focuses on site layouts and hence high level plant designs only, scenarios such as these have not been analysed as part of the current assessment.

Other key inputs and assumptions relating to the modelling of the odour emissions rates for ground sources were:

- The same odour emission rates were used for the Class B lagoons and the Class B storage tank for each scenario. This was due to the limited and variable SOER data available. A 'mid-range' SOER value was selected to represent these odour sources.
- The odour emission rate for fugitive emissions from the sludge dewatering building were based on estimates from two recent odour studies for Victorian STPs.
- Diurnal emission variations were applied for the sludge dewatering building. Odour emissions were assumed to occur for 8 hours each day, between the hours of 7 am and 3 pm.
- It was assumed that the sludge pumping facility will be fully and effectively contained such that there are no fugitive odours from this source.
- The RWTP was assumed to not contribute any significant odours to the site odour inventory.

5.3.2 Point source odour emissions

For odour sources which are subject to forced ventilation for odour capture, subsequent treatment is expected to be achieved using a dedicated odour control system (OCS). This would typically constitute a biological or chemical wet scrubbing system to remove the bulk of the H_2S and other odorous compounds (mercaptans, dimethyl sulphide, etc.), followed by polishing with an activated carbon treatment vessel to achieve the desired outlet odour concentration in the gas stream prior to release to atmosphere via a stack. The stack is represented as a point source emission in the odour model.

As shown in Table 5-4, three levels of odour mitigation were applied:

(i) 'limited', whereby only selected odour sources were assumed to be covered and/or ventilated,

(ii) 'mid-level' (increased number of odour sources with forced ventilation and treatment), and

(iii) 'high' (extensive odour capture and treatment).

A summary of the odour emission sources treated at an OCS for each of the three odour mitigation levels is provided in Table 5-5.

Table 5-5: Summary of odour mitigation applied for model scenarios

Odour mitigation level	Applicable scenarios	Emission sources treated by Odour Control Systems
Limited odour mitigation	A and D	OCS#1 - sludge feed tank and dewatered sludge storage tank.
Mid-level odour mitigation	B and E	OCS#1 - sludge feed tank, dewatered sludge storage tank and dewatering building. OCS#2 - Inlet Works and Inlet Pump Station OCS#3 - Anoxic tanks
High level odour mitigation	C and F	OCS#1 - sludge feed tank, dewatered sludge storage tank and dewatering building. OCS#2 - Inlet Works and Inlet Pump Station OCS#3 - Anoxic tanks + Primary Settlement Tanks

Assumptions and notes important to the odour mitigation and point source odour emissions for each scenario are:

- The implementation of more extensive odour mitigation does not always result in a lower total odour emission rate (ground level sources plus point sources) for the site. This is because of the influence of a variety of factors, including; different ventilation rates are selected for different source types (e.g. a high number of air changes per hour are used for sludge tanks compared to that for anoxic tanks), and the same stack outlet odour concentration is selected for each scenario (this is typically the minimum level the OCS technology supplier will guarantee).

- Forced ventilation gas flow rates used to estimate the point source emissions are preliminary only, for the purposes of dispersion modelling, and were based on a number of air changes per hour (ACH) appropriate for each asset ventilated.

- The influence of the sludge dewatering building on plume dispersion from the OCS stacks was incorporated in the models.

- For the Golina site modelling of point sources, the influence of a large berm, approximately 50 metres in width and 6 metres high, with sloped batters (slope of 1 in 4) on each side were incorporated. The berm follows the length of the southern and western perimeter of the Golina site. Sensitivity testing indicated that this berm did not impact the point source plume dispersion unless the berm was approximately 10 metres tall, or higher.

- The stack outlet design parameters assumed for each OCS are summarized in Table 5-6. These parameters are preliminary only but are within the typical range of stack heights expected for an OCS at a STP. It is anticipated that there will be some variation in the odour model outputs with different stack heights, however, the use of the same stack height in the model inputs enables a comparison of different mitigation options and site selection options. Similarly, the selected exit velocity (and temperature) may also affect the model results. Sensitivity of these changes has not yet been examined.

Table 5-6: Model inputs – stack emission parameters

Stack emission parameter	Units	Value
Stack height	m	12
Stack exit velocity	m/s	15
Stack exit gas odour concentration	OU	500
Stack exit gas temperature	deg.C	20

5.4 Odour Modelling Results

5.4.1 Model outputs

The model outputs shown in this section provide predicted ambient ground level OU concentrations for the proposed RWTP located at Golina, with production capacity of 20 Ml/d. These outputs correspond to the optimised plant layout (refer Section 6.1) at Golina.

In each plot, the 1 OU and 4 OU contours are shown (refer Section 5.2.3), with averaging period of 3 minutes and 99.9^{th} percentile outputs.

The red line is the proposed site boundary and the dark blue line depicts the Class B storage basin. The pink triangle denotes the Golina residence site and the green cross shows the location of the receptor within the adjoining quarry development site; refer Section 5.2.4.

Model outputs are provided below for:

- Case B – average odour emission rates, high level of odour mitigation; Figure 5.3
- Case C – average odour emission rates, high level odour mitigation; Figure 5.4
- Case E – peak odour emissions with mid-level mitigation; Figure 5.5.

Note the separate odour contours near Langley Park Drive are due to the Class B storage basin.

The model output for Case F (peak odour emission rates with high level odour mitigation) for the optimised Golina plant layout is provided in Appendix F. The model outputs associated with the Langley Park Drive site and for the preliminary plant layout at Golina are provided in the report 'Wollert RWTP Siting Risk Assessment Report', Jacobs, 2020.

Modelling outputs for other site location and plant size/configuration options (e.g. Langley Park Drive site option) which were assessed earlier in the project, as discussed in Section 2, are presented in the report 'Wollert RWTP Siting Risk Assessment Report', Jacobs, 2020. The outputs provided in this report correspond to the preferred location and plant configuration at Golina.

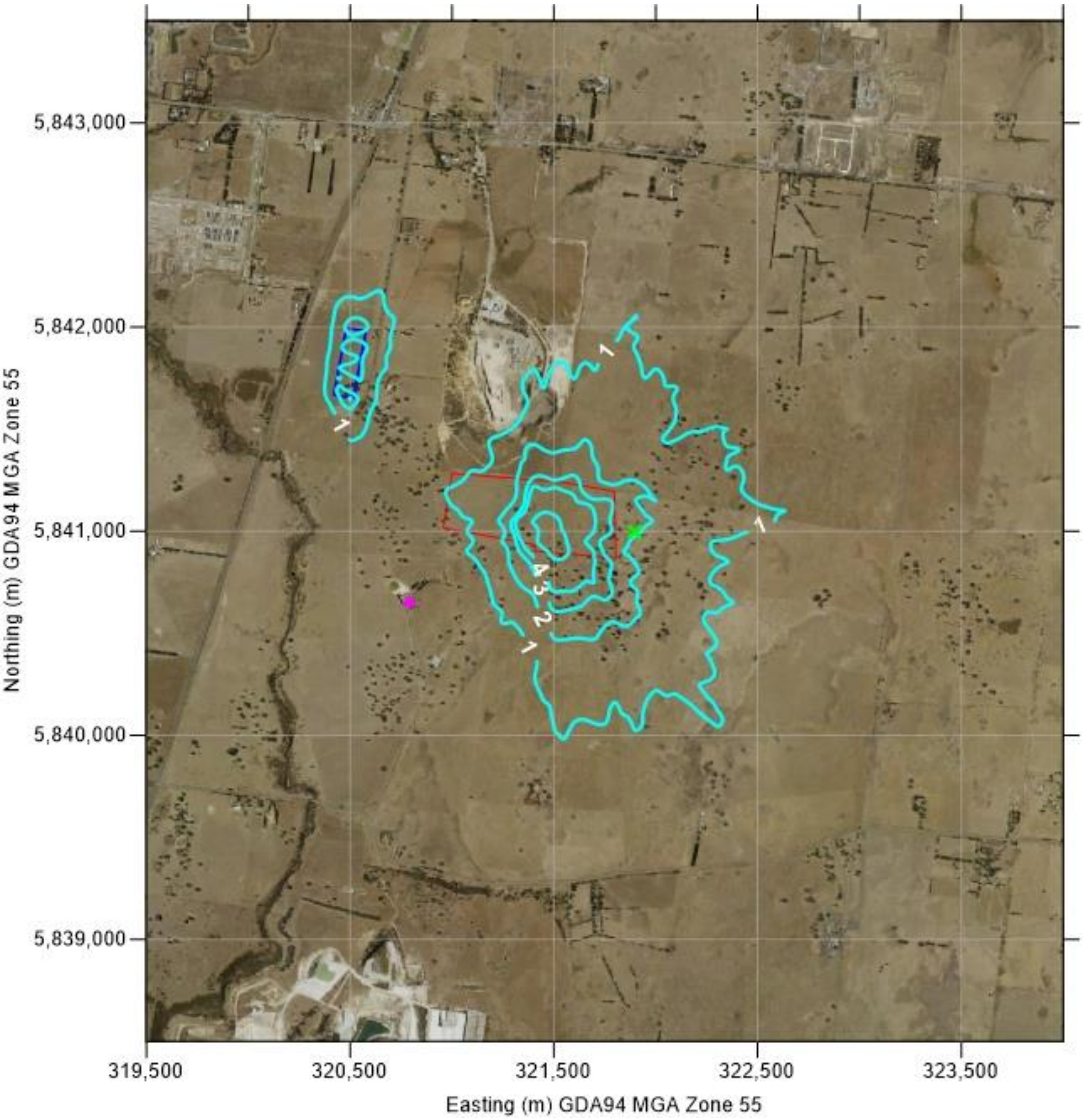

Figure 5.3: Golina 20Ml/d, average OERs and mid-level mitigation (Case B), 99.9th percentile odour levels (OU), 3 minute average

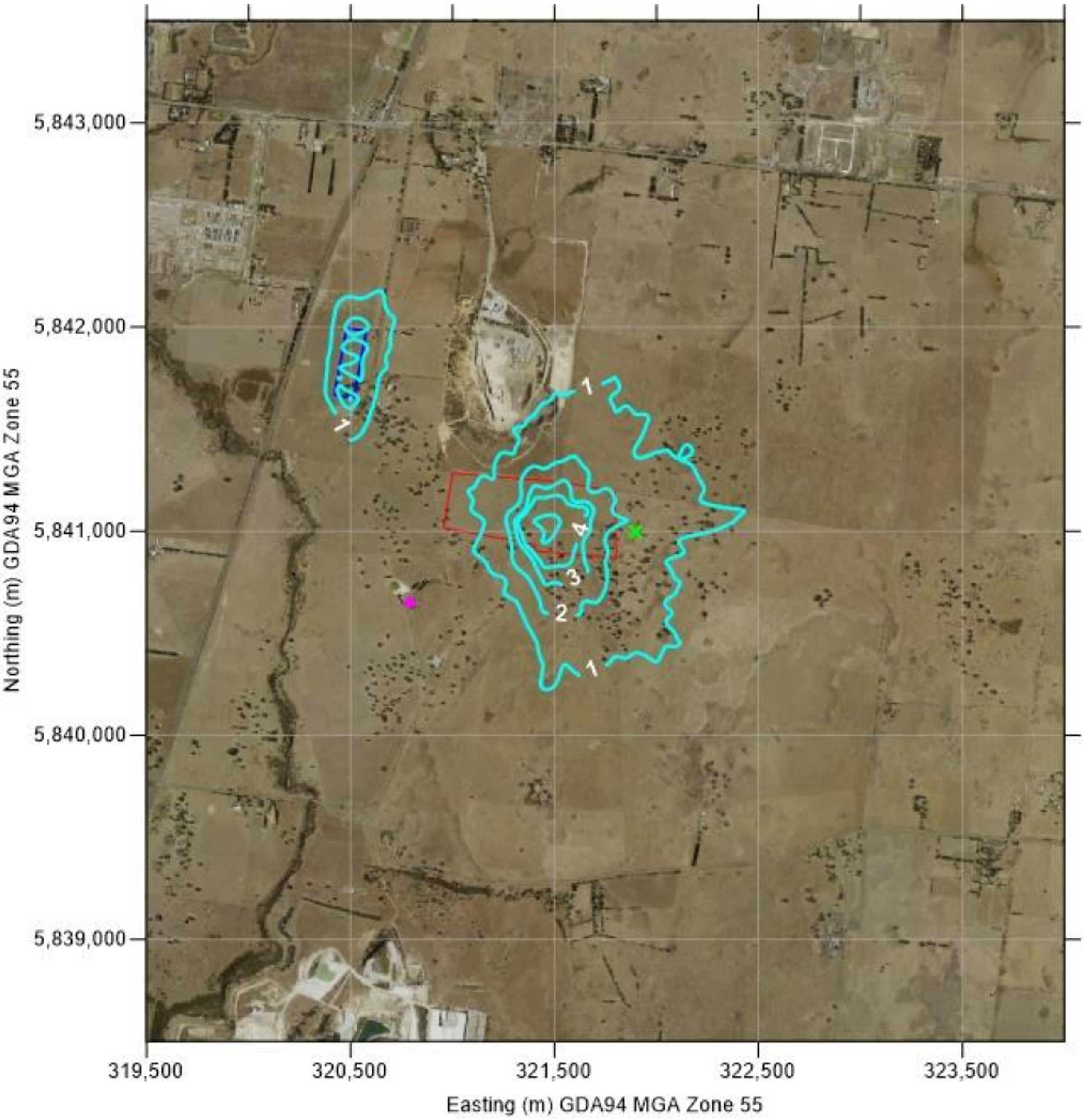

Figure 5.4: Golina 20 Ml/d, average OERs and high level odour mitigation (Case C), 99.9th percentile odour levels (OU), 3 minute average

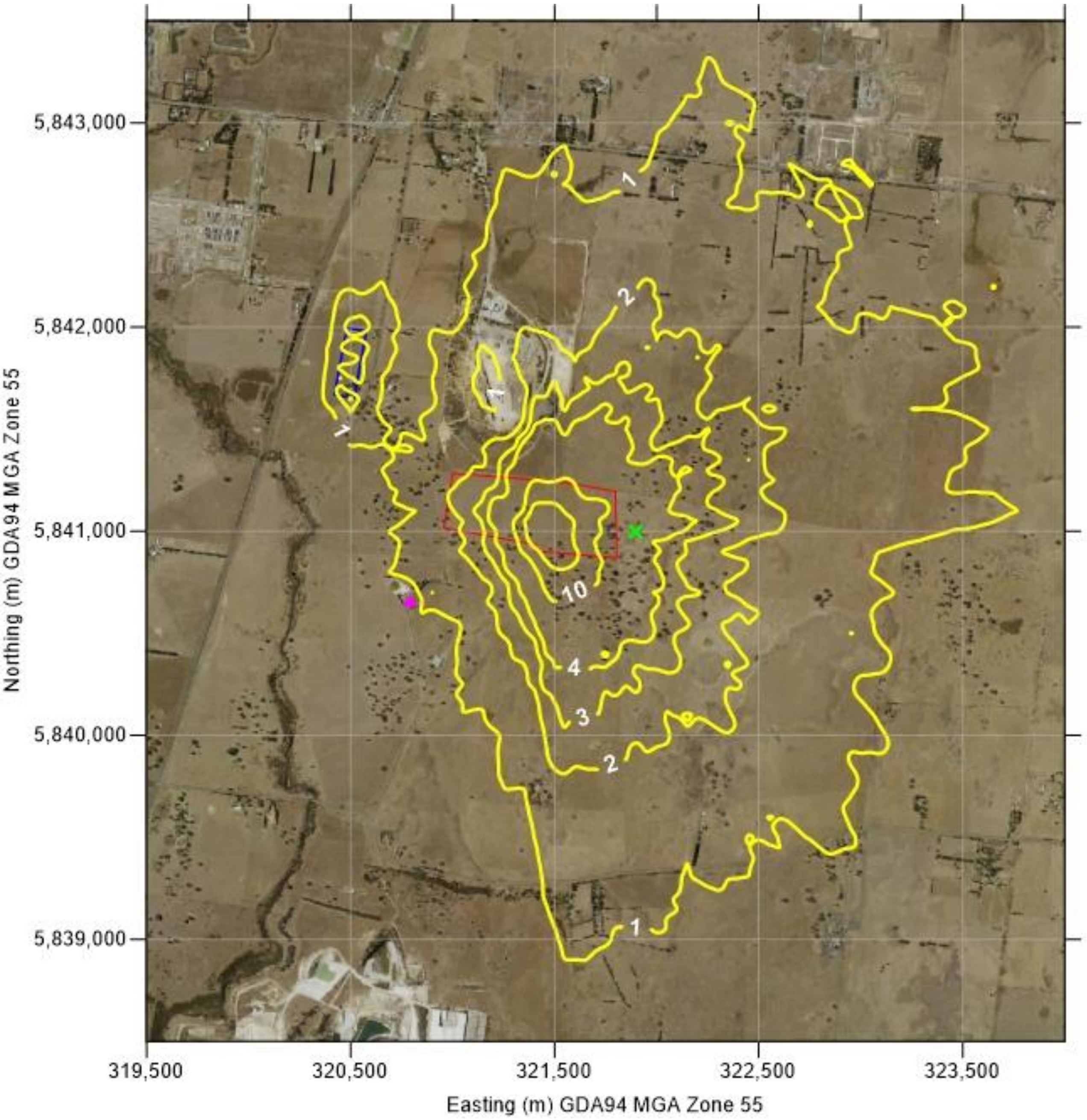

Figure 5.5: Golina 20 Ml/d, peak OERs and mid-level mitigation (Case E), 99.9th percentile odour levels (OU), 3 minute average

A summary of the predicted ambient odour concentrations at the Golina residence and at a location in the adjoining proposed industrial quarry site, near the eastern border of the plant site boundary, is provided in Table 5-4 for average odour emission rate scenarios, and Table 5-5 for peak odour emission rate scenarios. The tables also show the number of hours throughout the model year (8760 hours total) for which the design criterion (1 OU used for scenarios with average odour emission rates, and 4 OU applied for peak emission rate scenarios) is predicted to be exceeded.

Table 5-7: Summary of predicted OU levels at receptor sites for average OER scenarios

Model scenario	Golina Residence		Near eastern property boundary	
	Max predicted OU (99.9th %ile)	No. hours > 1 OU at receptor	Max predicted OU (99.9th %ile)	No. hours > 1 OU at receptor
Average OER, mid-level mitigation (Case B)	0.54 OU	1	2.2	97
Average OER, high level mitigation (Case C)	0.51 OU	1	1.5	57

Table 5-8: Summary of predicted OU levels at receptor sites for peak OER scenarios

Model scenario	Golina Residence		Near eastern property boundary	
	Max predicted OU (99.9th %ile)	No. hours > 4 OU at receptor	Max predicted OU (99.9th %ile)	No. hours > 4 OU at receptor
Peak OER, mid-level mitigation (Case E)	0.97 OU	0	6.0	26
Peak OER, high level mitigation (Case F)	0.83 OU	0	4.7	12

The results indicate that there will be no significant odour impact at the Golina residence site. Higher odour concentrations are predicted near (and outside) the eastern boundary, adjoining the proposed quarry site, however, the risk of offensive odour occurring at that location is considered to be relatively low due to the following factors:

- The predicted OU concentration for the peak odour emission rate scenarios, i.e. most conservative, are approximately 5 – 6 OU in this location. From Table 5-2, the odour is expected to be weak, but possibly distinct, and is considered unlikely to cause an odour nuisance unless it occurs frequently. Odour levels greater than 4 OU are only predicted by the model to occur for a relatively low percentage of time throughout the year.

- The modelling results indicate that odour levels greater than 4 OU will only occur during the evening and early morning hours, i.e. between 7 pm and 9 am when occupancy at the industrial site is less likely (to be confirmed by Barro).

- Under the high level odour mitigation scenarios, the odour sources at the STP which will not be covered are the aeration basins. These sources are considered to have a less-offensive character compared to that of the other STP sources such as the inlet works area and the sludge treatment and handling area.

- In addition to the character, frequency, duration, and strength of the odour, the potential for odour nuisance is dependent on the use of the land at the receptor location (i.e. whether used for living activities, recreation, etc.) and the reasonable expectation of air quality amenity. Insert info re types of activities, number of people likely to be present, etc. when known from Barro.

5.4.2 Summary and discussion of odour model results

Key findings resulting from the odour modelling are:

- For all cases, the highest odour risk was predicted by the modelling to occur to the east, north and south of the emission source locations. This was due to the predominant direction of low winds which are most influential for odour dispersion.
- The predicted odour GLCs for all cases exceeded the SEPP(AQM) 1 OU criterion at and beyond the site boundary. Further risk assessment to investigate the likelihood of odour impact was therefore carried out. This involved assessing the 4 OU criterion with respect to the likelihood of nuisance odour impact beyond the plant boundary.
- For the 'average' OERs, the predicted odour levels at the Golina residence are less than 1 OU, for both the mid-level and high level odour mitigation cases (Case B and C). This receptor site is not expected to be impacted by odour nuisance, for both mid-level and high-level odour mitigation options.
- For peak OERs, the predicted OU at the Golina residence is less than 4 OU, therefore not expected to be impacted by odour nuisance, for both mid-level and high-level odour mitigation options.
- Increasing the level of odour mitigation works decreased the extent of predicted odour impact, as expected. The extent of reduction of the odour impact was most obvious for regions closest to the emission sources.
- The ambient odour levels predicted by the model for the proposed quarry area near the eastern boundary of the STP site were higher than those at Golina residence receptor, however, the risk of odour nuisance impact here is considered to be relatively low.

As this study involved the high level layout design of a STP, there is significant uncertainty regarding the extent of the odour emissions for the site. The odour emissions will depend on a wide range of factors including the type and size of process units selected (e.g. MBR instead of SBR) and the quality of the influent sewage (e.g. the contribution of any trade waste). The use of average and peak odour emission rate estimates goes some way to address this.

The model-predicted odour impact is based on the existing topography for the site and surrounding areas. Should the terrain elevations and/or the land use change in the future, this may affect the model outputs. For example, changes in land use can affect the predicted odour contours. Much of the surrounding areas are flat and rural with not many trees. Encroaching urban areas will act to increase, to some extent, the surface wind turbulence. In some cases, the effect is sufficient to enhance dispersion of odour.

5.4.3 Victoria EPA guideline separation distances

The odour contour outputs in Section 5.4.1 are overlaid on the Shenstone SPS Plan 15 in Appendix C, to provide context of the odour contours relative to the proposed zoning of Shenstone PSP. The existing NDW treatment facility odour buffer on Plan 15 of the Shenstone PSP has been developed using the Victorian EPA guideline separation distance calculations. It is noted that this was completed for the previously proposed 45Ml/d NDW treatment facility. For completeness, below are the Victoria EPA guideline separation distances for a 20Ml/d facility.

Separation distances, per the Victorian EPA guideline (publication no. 1518 March 2013), are based on emissions during plant upset conditions, i.e. not normal operation. The calculated distances, based on a nominal loading of 180 L/d/EP, are listed in Table 5-9. It is noted that this is the method of calculation used to develop the odour buffer on the draft Shenstone PSP schematic, though this is based on parameter values for a 45Ml/d facility.

Table 5-9: Calculation parameters input to the Victoria EPA separation distances guideline calculation.

Parameter	Units	20 Ml/d plant
WWTP treatment capacity	Ml/d	28.5
WWTP output	Ml/d	20
Assumed L/d/EP	L/d/EP	180
Calculated EP	EP	158,333
Calculated separation distance	**m**	**541**

To analyse required separation distances, often odour inventories for different plant upset scenarios are generated and modelled, e.g. algae in lagoons, failure of aerators, etc. Scenarios such as these have not been analysed as part of the current assessment.

Appendix C. Wollert RWTP Siting Risk Assessment Report, Jacobs 2020

2. Siting Assessment

2.1 Treatment Process Sizing

The treatment plant options at both sites are sized to produce 20 Ml/d NDW by extracting sufficient untreated wastewater from the adjacent Lockerbie Main Sewer (i.e. sewer mining, rather than a conventional 'end of pipe' treatment plant). It has been assumed that an end-to-end (i.e. inlet of sewage to STP through to production of NDW) recovery rate of 70% can be achieved by the facility. This is a typical end-to-end recovery rate for conventional recycled water treatment plants. For a 20 Ml/d NDW production rate a sewage influent flowrate of approximately 28.5 Ml/d is therefore required.

The treatment process units included are largely as per the Kalkallo Sewage Treatment Plant Resource Recovery Options Investigation (RROI) Report, Revision F (20th March 2015) which included a broad range of treatment process units to accommodate future resource recovery options. This has been carried through to this site sizing assessment to ensure full process flexibility when this facility is designed in the future. Complex sludge treatment has been excluded as per discussion with the YVW project team, since its cost effectiveness is marginal for a treatment plant of this size. A sludge dewatering facility has been included as YVW's standard operating practice is to dewater the sludge before transporting it to a facility that can appropriately use or dispose of the sludge.

We have conservatively located the assets that are most likely to be high odour-emitting assets close to sensitive receptors. This was done to reduce the risk that adjustments to the layout during design development would increase the risk profile compared to what has been assessed for this report.

A summary table of the treatment process units is provided in Table 2-1. Refer to the design basis register, Appendix A, for detail of each process unit sizing.

Table 2-1: High level STP process unit sizing

Process unit	No. of units	Size
Sewage Treatment Plant		
Influent sewage pump station	1	15m x 20m
Inlet works (grit removal, screens)	1	15m x 20m
Odour control facility	1	15m x 20m
Primary Settlement Tanks	2	20m dia, 4.5 depth
Sequential Batch Reactors (SBRs)	2	100m x 34.5m
Secondary Clarifiers	2	35m dia, 4.5m depth
UV System	1	20m x 30m
Sludge Pumping Facility	1	10m x 10m
Sludge Feed Tank	1	8m dia
Sludge Holding Tank	1	8m dia
Sludge Dewatering Facility	1	20m x 25m

Process unit	No. of units	Size
Class B Storage Basin	1	Usable volume= 95Ml (100m x 340m x 4m) Total volume= 136Ml
Recycled Water Treatment Plant		
Class B storage/balance tank	1	20m dia. tank
Membrane filtration building	1	50m x 25m
Micro-filters, Feed Pumps, Class A Pumps	1	10m x 10m
Recycled water tank	1	20m dia tank
UV System	1	15m x 12m

Both sites are heavily impacted by the nearby quarry fly rock buffers. The area on both sites that are covered by the fly rock buffer has been excluded because YVW have deemed the perceived risk of flyrock to personnel and assets is unacceptable. The area available outside planning and other constraints (principally the fly-rock buffer at both sites, and landscaping required as part of the Golina purchase agreement) is:

- 86,200m^2 at the Langley Park Drive site and;
- 37,000m^2 at the Golina site.

Jacobs has previously developed a high-level STP/RWTP site sizing tool to indicate the approximate footprint of proposed treatment facilities. The inputs are a range of existing treatment facilities from around Australia, with the flowrate capacity correlated to the footprint of the facility. This tool has been used as a sensibility check for the proposed Wollert sites. The tool indicates a minimum footprint of 48,500m^2 is required for a 20Ml/d facility. The preliminary treatment facility footprints (including ancillary assets) developed for Langley Park Drive and Golina sites are 49,000m^2 and 76,000m^2 respectively. The Golina site treatment facility footprint is approximately 50 % larger than the Langley Park Drive footprint as the narrow site footprint makes it challenging to arrange the treatment assets in a space-efficient manner. As evident in the site layout (Appendix B), this reduces the usable space for treatment process units, and in turn the flexibility of the site layout, and results in a larger footprint than what is available between the proposed Woody Hill blast buffer and existing Conservation Area: 28 overlay.

2.2 Site Locations

Two sites have been considered for site layout assessment, as discussed in this section. Both sites are shown on Figure 2-1.

Appendix F. Odour Model Outputs

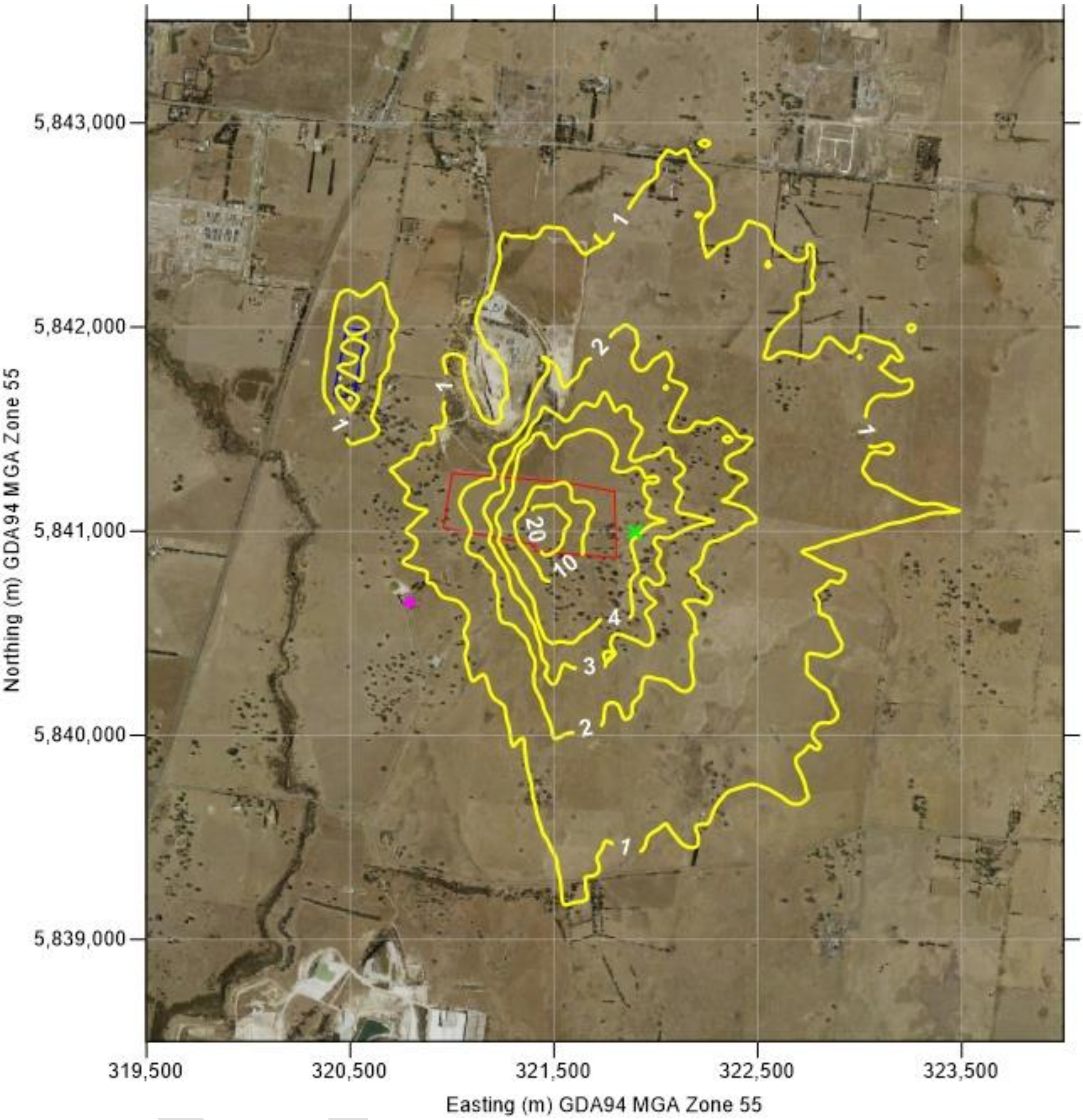

Figure 6.3: Golina 20 Ml/d, peak OERs and high level mitigation (Case F), 99.9th percentile odour levels (OU), 3 minute average