

Water Corporation

Buffer Zone for East Rockingham Wastewater Treatment Plant

Referral of Stage 1 Development



November 2010



Consulting Environmental Engineers

Buffer Zone for East Rockingham Wastewater Treatment Plant

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Water Corporation

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*This report constitutes the professional opinion and judgement of
Consulting Environmental Engineer*

1. Introduction

The Water Corporation is planning a major new wastewater treatment plant (WWTP) in the Kwinana Industrial Area at East Rockingham. The proposed site is on Mandurah Road, East Rockingham, between Wellard Road and Dixon Road. The area is zoned heavy and general industrial in the City of Rockingham Town Planning Scheme and the Metropolitan Region Scheme.

The plant will provide full secondary treatment with the potential to be augmented to later provide microfiltration if required. The plant will be developed in stages up to an ultimate flow of 160 ML/d over the next sixty years, providing capacity to handle the wastewater from 700,000 persons, or the equivalent in flows from industrial and commercial premises.

Figure 1 shows a concept layout of the East Rockingham WWTP. The proposed treatment processes involve preliminary treatment (screening and grit removal), primary sedimentation and secondary treatment in oxidation ditches (an extended aeration process that achieves high nitrogen removal). In Stage 1, the solids collected in the treatment processes will be thickened, dewatered and carted from the site for reuse. In later stages, they will be digested. A high quality effluent will be produced, which will be available for reuse locally.

Background to Odour Modelling

The Water Corporation originally requested CEE to carry out odour modelling for the proposed East Rockingham WWTP in June 2008 using winds measured in 2006 on the site to assess the potential effects of odours from the plant and to define an appropriate buffer zone for the plant.

In that assessment, a comparison was made of methods that can be used to calculate atmospheric stability (effectively the horizontal and vertical mixing rates) from meteorological measurements at the site. The two methods compared were: (1) to calculate stability category from net solar radiation and (2) to calculate stability category from solar radiation by day and vertical temperature profile by night. It was found that the pattern of the predicted odour contours is essentially the same using the two methods of calculating stability category and the buffer zone is not sensitive to this meteorological parameter.

Measurement of winds continued and now there are three years of wind records (2006 - 2008). Thus the Water Corporation requested that the modelling work be repeated using the three years of wind records. This work established that year to year variations in wind patterns had very little influence on the recommended buffer zone.

In 2010, a new layout for the plant was developed that compressed the plant into a smaller area of land, and re-arranged the treatment processes on the site. Thus the Water Corporation requested CEE to repeat the odour modelling and buffer zone assessment using the new plant layout.

Scope of Work

The scope of work is set out in the Brief issued by the Water Corporation in February 2010 as follows.

1. Develop estimates of odour emissions from each of the development stages of the East Rockingham plant with and without covers on various treatment units;
2. Identify a wind file suitable for modelling dispersion in the vicinity of the plant to predict odour contours;
3. Undertake *Ausplume* modelling of odour dispersion from the plant to predict odour contours;
4. Confirm the odour criteria that should be used to assess odour effects in an industrial zone;
5. Advise on the size of an appropriate buffer zone based on the results of this odour study, experience elsewhere and appropriate odour management measures;
6. If the predicted odour contours for the new plant layout extend into a residential area, advise on how many of the proposed stages of the East Rockingham plant can be built or what additional odour control measures could be implemented to fit the plant within the available industrial area with no predicted odour nuisance in the residential or commercial zones;
7. Produce a report on the buffer zone study for the proposed East Rockingham WWTP.

2. East Rockingham Wastewater Treatment Plant

The new layout of the proposed East Rockingham WWTP, which forms the basis of the odour modelling in this study, is shown in Figure 1. The proposed ultimate plant will treat 160 ML/d with screening, grit removal, primary treatment, secondary treatment using oxidation tanks and clarifiers, anaerobic sludge digestion, use of the digester gas in energy generation and water reclamation for recycling.

Four Stages of Development

As illustrated in Figure 1, the East Rockingham plant is to be developed in four stages, each of 40 ML/d capacity.

Stage 1 – 40 ML/d (about 2015)

In the first stage with capacity of 40 ML/d, there will be a short-term screening and grit removal facility and two secondary treatment trains. The following units will be installed:

- Inlet works with 2 screens and 2 grit tanks;
- 1 bioselector;
- 2 oxidation ditches;
- 3 secondary clarifiers;
- 1 DAF tank for thickening excess secondary sludge;
- 1 thickened sludge storage tank; and
- 1 effluent flow balancing tank.

The thickened sludge from the DAFT will be dewatered and carted by trucks from the site.

Stage 2 – 80 ML/d (about 2027)

In the second stage, the capacity will be increased to 80 ML/d by building a new permanent inlet works and installing primary treatment. Two egg shaped digesters (like at Woodman Point) will be constructed to digest the sludge on the site, with an associated digested sludge storage tank.

For Stage 2, the following units will be installed:

- New inlet works with 2 screens and 2 grit tanks;
- 2 primary sedimentation tanks (PSTs);
- 1 new bioselector;
- 1 new secondary clarifier;
- 1 DAF tank for thickening excess secondary sludge;
- 1 primary sludge thickening unit;
- 2 egg shaped anaerobic digesters;
- 1 digested sludge storage tank; and
- Energy recovery facilities.

The thickened sludge from the DAFT and the primary sludge thickeners will be digested to recover gas and stabilise the sludge. The digested sludge will be dewatered in an enclosed and ventilated building and carted in trucks from the site. The gas from the digesters will be scrubbed, stored and used to run turbines to generate electricity.

Stage 3 – 120 ML/d (about 2040)

In the third stage, the capacity will be increased to 120 ML/d by expanding the primary and secondary treatment facilities. For Stage 3, the following units will be installed:

- 2 additional screens
- 2 additional grit tanks;
- 1 primary sedimentation tank (PST);
- 1 new bioselector;
- 1 new oxidation ditch;
- Covers on all oxidation ditches;
- 2 new secondary clarifiers;
- 1 DAF tank for thickening excess secondary sludge;
- 1 primary sludge thickening unit;
- 1 egg shaped anaerobic digester;
- 1 digested sludge storage tank; and
- 1 effluent flow balancing tank.

As shown in Figure 1, the Stage 3 secondary treatment units are proposed to be built on the east side of the proposed plant. There will be an expansion in processing and sludge storage facilities, and in gas engines, within the buildings constructed in Stage 2.

Stage 4 – 160 ML/d (about 2070)

In the final stage, the capacity will be increased to 160 ML/d by expanding the primary and secondary treatment facilities. For Stage 4, the following units will be installed:

- 1 primary sedimentation tank (PST);
- 1 new bioselector;
- 1 new oxidation ditch (with covers);
- 2 new secondary clarifiers;
- 1 DAF tank for thickening excess secondary sludge; and
- 1 extra anaerobic digester.

As shown in Figure 1, the Stage 4 secondary treatment units are proposed to be built on the east side of the proposed plant. There will be an expansion in processing and sludge storage facilities, and in gas engines, within the buildings constructed in Stage 2.

The odour modelling, as presented later in this report, shows that additional odour management works are required to contain the extent of odour from the Stage 4 plant within the industrial area. The Stage 4 expansion is currently planned for construction in about 2070, which is sixty years in the future. The treatment, sludge handling and odour treatment processes that will actually be constructed in Stages 3 and 4 may well be different to those described in this report, possibly with smaller process areas and improved odour capture rates.

Stages 1 to 3 of the East Rockingham treatment plant can be constructed with an acceptable odour footprint using existing technology, For Stage 4, it is anticipated that new odour control technology that becomes available over the next sixty years will allow the plant to be developed with a smaller odour footprint than predicted using current odour control technology.

3. Odour Emission Rates

As the East Rockingham plant is yet to be developed, odour emission rates for the proposed plant were developed from measurements of odour emission at the existing Subiaco, Beenyup, Mandurah, Albany, Broome, Geraldton and Woodman Point treatment plants over the past four years.

The estimates of odour emission rates for the East Rockingham plant are summarised in Table 1. Substantially higher emission rates apply for units that do not have covers. It should be noted that the emission rates allow for normal operations and maintenance of the covered tanks, and hence refer to emissions at times when a small part of the unit is open for replacement of equipment (but following cleaning prior to covers being removed).

Table 1 Odour Emission Rates for East Rockingham WWTP

Treatment Unit	Open emission rate, OU.m ³ /m ² .s	Covered emission rate, OU.m ³ /m ² .s
Inlet Area	8 - 15	2 - 3
Primary treatment	-	3
Selectors	-	1
Oxidation ditches	1.2 – 1.5	0.4 – 0.8
Secondary clarifiers	0.5	-
Sludge Thickening	-	1 - 3
Sludge digestion	-	18
Sludge processing	Building	Building

Table 2 and Figure 2 illustrate the total odour emissions at ground level from the various stages of development of the East Rockingham plant. It can be seen that the odour emissions from the Stage 1 plant (50,160 OU.m³/s) are similar to those from the Stage 3 plant with covers (51,080 OU.m³/s). This is achieved by covering the oxidation ditches and providing odour capture on sludge processing units in later stages.

It is assumed that covers on the oxidation ditches would be used from Stage 3 on, to limit the increase in odour emissions from the plant increase as extra treatment facilities are provided. As a result, the projected odour emissions from the covered Stage 3 plant of 51,080 OU.m³/s are essentially the same as from the Stage 1 plant.

The temporary inlet and screening area will be covered in Stage 1. In Stages 2 and 3, a new inlet works will be provided with covers on all channels and bins, and extraction of air from the covered areas and equipment in accordance with the design rates used by the Water Corporation at other plants (eg, Beenyup, Woodman Point, Mandurah).

Table 2 Summary of Odour Inventory for East Rockingham WWTP

East Rockingham Odour Source	Odour Emission, OU.m ³ /s		
	Stage 1	Stage 3	Stage 4
Temporary inlet	3,960	0	0
Inlet area	0	2,380	2,380
Primary area	0	7,530	9,940
Bioselectors	15,540	2,520	3,120
Oxidation ditches	17,550	11,880	15,840
Secondary clarifiers	3,030	6,050	8,000
DAF Tanks	140	430	580
Sludge thickening	1,300	2,600	2,600
Sludge digestion	0	2,700	3,600
Sludge storage	2,040	1,530	1,530
Sludge gas	0	1,160	1,160
Sludge processing	3,500	4,000	4,000
Sludge load-out	3,100	2,300	2,300
Energy recovery	0	6,000	8,000
Total, ground level	50,160	51,080	63,050
Stacks	6,000	56,000	66,000

In Stage 4 of the plant, the primary and secondary treatment facilities will be further expanded, and the additional secondary treatment units are proposed to be built on the east side of the proposed plant. There will be an expansion in sludge thickening and digestion facilities.

New Process and Odour Control Systems in Stage 4

The projected total odour emissions from the Stage 4 plant are 63,050 OU.m³/s, as shown in Table 2. To reduce the total ground level odour emissions in Stage 4 to about the same as for Stages 1 and 3, additional enclosures or other odour control technologies are required.

The Stage 4 expansion is currently planned for construction in sixty years and the treatment, sludge handling and odour treatment processes that will actually be constructed in Stage 4 should be more advanced than those used now.

4. Odour Objective

In March 2002, the WA EPA issued a Guidance Statement on the Assessment of Odour Impacts (Guidance Statement No 47) to define odour objectives. This Guidance Statement was withdrawn for review in November 2005 and, in the interim, the EPA advises that the procedure noted below should be followed.

When assessing new proposals or expansions with the potential to cause odour impacts on existing sensitive land uses or when assessing new developments near existing odour sources, the EPA will use the following process:

- i) *If generic buffer distances are met (as set out in EPA Guidance Statement No. 3 or in appropriate Codes of Practice or Statements of Planning Policy developed by the WA Planning Commission) and the proposed facility is designed for “best practice” emission control (EPA Guidance Statement No. 55), then no further assessment of odour is required.*
- ii) *If a generic separation distance is not met, it may nevertheless be possible for the proponent to demonstrate acceptability by undertaking a conservative but relatively simple screening procedure which assesses odour impact against a two-part “green light” criterion, as follows:
Computer modelling must be undertaken using either a measurement or reliable estimate of odour emission rate (in odour units per second, OU.m³/s) in order to demonstrate that the ambient odour concentration does not exceed the following two-part “green-light” criterion at existing or proposed odour sensitive premises:
a) 2 OU, 3 minute average, 99.5th percentile
AND
b) 4 OU, 3 minute average, 99.9th percentile
If the above two-part criterion is met, no further assessment of odour is needed.*
- iii) *Proposals which do not meet the two-part “green-light” criterion above will be assessed on a case-by-case basis, including a determination of the form of odour impact study required.*

In 2005, the EPA issued *Environmental Protection Guidance Statement No 3: Separation Distances Between Industrial and Sensitive Land Uses* which recognises that wastewater treatment plants are a class of industry that require a buffer between the treatment plant and sensitive land uses, such as residential housing. Although buffer distances are specified for sewage pumping stations, EPA Guidance Statement No 3 does not provide buffer distances for wastewater treatment plants and notes that these are to be defined on a case by case basis. Hence there are no generic buffer distances defined by the EPA for the proposed East Rockingham WWTP.

The ‘green light’ criteria are conservative and it is considered to be more appropriate to define the buffer zone based on experience with other wastewater treatment plants in WA. Based on the correlation of odour complaints in residential areas and odour modelling around the existing Subiaco, Mandurah, Woodman Point and Beenyup WWTPs, the Corporation has ascertained that the **5 OU** (odour unit) level of odour encompasses odour complaints from the community and also the zone in which odour can be perceived as a nuisance, when the 5 OU contour is calculated using the Ausplume model at 99.9 percentile frequency over a 60 minute averaging period (*Ref. Wallis, IG and Oma, R, “Experience in Odour Management in Western Australia”, Third IWA Conference, Barcelona, 2008*).

Odour Criterion for Residential Areas

Thus the Corporation uses the 5 OU contour and the 99.9 percentile odour frequency level to assess the buffer zone to protect residents in urban zones from odour nuisance. This percentile limit allows exceedence of the odour limit for only 8 hours per year and provides a high level of protection to the urban community against odour nuisance.

In this report, the extent of possible odour risk in residential areas, and the recommended buffer zone for the East Rockingham WWTP, is based on the 5 OU contour at 99.9 percentile over a 60 minute averaging period. The 5 OU criterion applies to the residential areas commencing about 1.2 km south of the site and 1.7 km west of the site.

Odour Criterion for Industrial Areas

Figure 3 illustrates the zoning in the area surrounding the East Rockingham site in the *City of Rockingham Town Planning Scheme*. The area to the north of the plant is zoned "special industry" (dark purple) and the expected land uses within this zone will include heavy equipment storage, sand blasting and pipe manufacture), manufacturing industries of various types and commercial activities (car repairs, marine supplies, etc). The area to the west, south and east of the plant is zoned "general industry" (light purple). The strip along the south of the general industry is zoned "light industry" (pink) and comprises a wide range of establishments in repairs, furniture and general retail.

The odour criterion in the industrial zones is less stringent than for residential areas for the following reasons:

- Background odour levels are higher;
- Expectation of amenity in terms of odour is lower;
- The population density is lower than in a residential area; and
- Many sites are not occupied at night, when higher odour levels occur.

In NSW, odour criteria are based on the population density and range from a limit of 2 OU for a high density urban area to 7 OU for a rural area (at a lower frequency of 99 percentile). This reflects a risk-based approach which recognizes that risk is (approximately) proportional to population density.

Similar reasoning has been applied to intensive agricultural activities in semi-rural areas and this has been broadly recognized in most jurisdictions (including WA) by a less stringent odour criterion for intensive agriculture (piggeries, feedlots, chicken farms) of 7 OU at the 99.5 percentile frequency. This is equivalent to 10 to 12 OU at the 99.9 percentile frequency.

In this report, the extent of possible odour risk in industrial areas, and the recommended buffer zone for the East Rockingham WWTP, is based on the 7 OU contour at 99.9 percentile over a 60 minute averaging period. This odour level of 7 OU involves only a small relaxation from the urban residential criterion and a higher odour level could be used for many industrial uses.

An intermediate odour criterion of 6 OU is adopted for the light industry/commercial zones.

5. Wind Conditions

A wind monitoring station was installed at the East Rockingham plant site in January 2006. The Water Corporation provided a 36 month file (2006-2008) for the East Rockingham site for use in odour modelling. The coordinates of the wind and meteorological measurement site (in MGA 94) are:

East: 384,723

North: 6,429,841.

The accuracy of the monitoring equipment is listed below:

- Wind speed (+/- 0.07 m/s; threshold of 0.22 m/s);
- Wind direction (+/- 2 degrees);
- Air temperature (+/- 0.1 degrees C);
- Solar radiation (+/- 30 W/m²);
- Net solar radiation (+/- 30 W/m²).

A stability category is used to calculate the rate of dispersion in the atmosphere. The stability category is developed from net solar radiation using methods set out by the US EPA.

The annual wind roses for East Rockingham for all hours and for night time hours only are shown in Figures 4 and 5, respectively. The black bars near the centre of the wind rose represent the low speed winds (less than 1 m/s). The width of the bars represents the strength of the winds in each sector, with wider bars representing stronger winds. The length of the bars represents the proportion of winds in each sector, with longer bars indicating more winds from the sector.

Figure 4 shows that winds at East Rockingham come predominantly from the southwest, with southerly and easterly winds also being common. There are very few winds coming from the west to north sector at East Rockingham. Most of the low speed winds come from the east to southeast sector.

During the night time hours, the wind speeds are much lower (Figure 5), with a higher proportion of winds less than 1.0 m/s (shown by the black lines in near the centre of the wind rose). The highest proportion of low speed winds come from the east to south east sector during the night. Again, there are very few winds from the west to north sectors during the night.

The frequency distribution of wind speeds shows the following:

- 10 percentile wind speed = 0.8 m/s;
- 50 percentile wind speed = 2.8 m/s;
- 90 percentile wind speed = 5.3 m/s.

Similar wind speed patterns have been found at other plants, with slightly lower median speeds at Subiaco WWTP (2.5 m/s); the same median speed at Beenypup WWTP (2.8 m/s) and slightly higher median speeds at Woodman Point WWTP (3.4 m/s). From this comparison, it is considered that the wind measurements at the East Rockingham WWTP site are reasonably representative of long term wind patterns.

6. Odour Modelling

Odour modelling for this assessment has been carried out using the following procedure:

- Ausplume model version 6.0 as issued by the Victorian EPA;
- Odour emission rates as listed in Table 1;
- 60-minute averaging times;
- Meteorological file for East Rockingham as described above; and
- Other model parameters (eg, roughness) to best suit the East Rockingham WWTP area.

The odour model has been used to predict 99.9 percentile odour contours in the vicinity of the proposed WWTP. As explained above, the 5 OU contour is used to delineate the extent of noticeable odour in a residential area, the 6 OU contour is used to delineate the extent of noticeable odour in a commercial area and the 7 OU contour used to delineate the extent of noticeable odour in an industrial area.

7. Odour Predictions

The predicted odour contours for the various stages in the development of the East Rockingham WWTP are shown in Figures 6 to 8. The 5 OU contour is shown as a dotted red line and the 7 OU contour is shown as a solid purple line.

Odour Predictions for Stage One - 40 ML/d Plant

Figure 6 shows the predicted odour contours for the East Rockingham WWTP for a 40 ML/d plant with covers on the inlet channel, screens, grit tanks, flow splitter, screenings equipment and bins and grit processing and bin, and associated pits. The oxidation ditch, sludge processing and thickened sludge storage will be operated as aerobic processes in Stage 1 and hence will not be covered.

The predicted 7 OU contour extends about 400 m to the east of the boundary of the proposed treatment plant, about 700 m south, 1,200 west and 1,000 m north. Thus the predicted 7 OU contour is entirely within the land zoned industrial.

The predicted 5 OU contour extends 200 to 300 m further away from the plant than the 7 OU contour. Even so, the predicted 5 OU contour is entirely within land zoned industrial and does not extend to the commercial area south or to the residential areas to the north-east and south.

It is concluded that the 40 ML/d Stage 1 plant can be operated without covers on the oxidation ditches and other aerobic processes, although covers and odour scrubbing will be required in the inlet area. It is assumed that the air collected from beneath the covers will be treated by odour scrubbing units, with a 20 m high discharge stack for the scrubbed gas.

Odour Predictions for 120 ML/d Plant

Figure 7 shows the predicted odour contours for the East Rockingham WWTP for the Stage 3 plant at 120 ML/d capacity with full odour control, including covers on the oxidation ditches. As a large volume of air is to be scrubbed, it is assumed that a centralised scrubbing facility will be provided in Stage 2 and expanded in Stage 3. The facility will have bioscrubbers followed by chemical polishing scrubbers, as recently installed at the Woodman Point plant, with a 50 m high discharge stack.

It can be seen that the predicted odour contours are slightly elliptical, with the major axis being east-west. The predicted 7 OU contour extends about 500 m east of the plant boundary, 600 m south, 1,000 m west and 800 m to the north. The predicted 5 OU contour is 200 m to 300 m further away from the plant boundary than the 7 OU contour.

It is noted that the predicted 7 OU contour extends to Mandurah Road but remains within the area zoned industrial. The predicted 5 OU does not extend to the residential areas to the north-east and south of the plant, and is entirely within land zoned industrial. The 6 OU contour would not extend to the commercial area to the south.

Odour Predictions for 160 ML/d Plant

Figure 8 shows the predicted odour contours for the East Rockingham WWTP for a possible future 160 ML/d plant with the same level of odour control as the Stage 3 plant.

The larger 160 ML/d plant would have a larger footprint, because of the additional treatment units. It can be seen that the predicted odour contours are more circular, with a small extension of the odour contours to the west.

The Stage 4 plant would not be required until the year 2070. By that time, new and better odour control technology is expected to be required. However, if the same control technology as currently available is used in the model, the predicted 7 OU contour extends about 700 m east of the plant boundary, extending about 150 m into the land on the east of Mandurah Road.

The predicted 7 OU contour for the Stage 4 plant is within the zones depicted in Figure 3 as special and general industry. The 7 OU limit is assumed to apply in the industrial area to the east of the site and so the predicted odour levels would meet the odour limits for the East Rockingham area.

The 6 OU contour (intermediate between the 5 OU and 7 OU contours) would not extend into the commercial area to the south of the plant. Hence no odour nuisance is expected from the covered 160 ML/d plant in the residential or commercial zones.

The predicted 5 OU contour is 200 m to 500 m further away from the plant boundary than the 7 OU contour. The predicted 5 OU contour is well away from residential land to the south and northeast of the plant, but comes close to residential land to the west of the plant. Even so, no odour nuisance is expected from the covered 160 ML/d plant in the residential zones.

The predicted 5 OU contour does not extend into residential areas. The 6 OU contour (intermediate between the 5 OU and 7 OU contours) would not extend into the commercial area to the south of the plant. Hence no odour nuisance is expected from the covered 160 ML/d plant in the residential or commercial zones.

As noted earlier, the Stage 4 plant will be developed after 2070 for a flow of 160 ML/d and is sixty years in the future. Measurements of actual odour emissions will be made after each stage of development to refine the designs for odour management in subsequent stages. Enclosures to achieve secondary containment of odour are possible but would require very large extraction rates with associated high power use.

Better methods for odour control are expected to be available before 2070 and consequently the Water Corporation has agreed to design the Stage 4 upgrade to keep the 7 OU contour within the zone recommended in Figure 10.

8. Recommended Buffer Zone

Wastewater treatment plants receive and must treat all of the liquid wastes discharged by the community to the sewers. A modern wastewater treatment plant has several functions:

- Remove detritus and other solid and gritty objects from the wastewater;
- Remove organic solids and convert into useful products for reuse;
- Remove dissolved constituents to meet water quality standards;
- Remove nitrogen and phosphorus to meet environmental objectives;
- Remove pathogens to protect public health;
- Control odour and noise emissions and
- Produce a reclaimed water stream for subsequent reuse.

Even with good pollution control technology and careful operations, there will be a base level of odour emissions and, at times, a greater emission as a result of plant upsets and discharge of high contaminant loads to the sewers. These events are part of the management of a treatment plant and should be recognized in land use planning around wastewater treatment plants. An adequate buffer zone allows such emissions to dissipate without significant adverse effects on sensitive land uses beyond the buffer.

The buffer zone is not, of course, an alternative to 'best practice' operation of all components of a sewerage system, including responsible management of the sewage collection system, treatment system, reuse operations and disposal systems.

From consideration of the predicted odour contours shown in Figures 6, 7 and 8, a recommended buffer zone for the proposed East Rockingham treatment plant has been defined. Figure 9 illustrates the predicted 7 OU contour for the proposed Stage 1 plant (red line), Stage 2 plant (mid-green line) and Stage 3 plant (dark blue line), as well as the future possible 160 ML/d plant (dotted purple line) prior to extra odour control.

A recommended buffer zone also is shown in Figure 9 (solid orange line), in relation to the predicted odour contours and land zoning. It can be seen that the recommended buffer area is an 11-sided zone that is entirely on land zoned industrial between Mandurah Road (to the east) and the railway (to the west), and encompasses the predicted 7 OU contour for the Stage 1, 2 and 3 plants at East Rockingham.

Stage 4 is about sixty years in the future and it will be planned and developed to so that the projected 7 OU contour is within the buffer zone shown in Figure 9.

Figure 10 shows the buffer zone in relation to existing land use. It can be seen that there are no residences or odour-sensitive premises within the recommended buffer zone. The buffer area can be used for heavy industry or similar uses that are not sensitive to odour and are thus compatible with the proximity of the treatment plant.

The development of the East Rockingham WWTP with a defined buffer zone within an industrial area will avoid the risk of future encroachment of odour-sensitive premises. In addition, it is recommended that the Corporation plan the future treatment plant at East Rockingham with fully covered tanks and a high degree of odour control.

9. Odour Management Plan

An Odour Management Plan is required prior to final design and construction to ensure the intended level of odour control is incorporated into the design, construction and operations of the East Rockingham WWTP.

There are several stages in the development and operation of a wastewater treatment plant and the components of the Odour Management Plan should be arranged so that they can be addressed in the correct sequence.

The stages of development, and the works required to achieve effective control of odours at the East Rockingham WWTP are shown below in Table 3. The detailed Odour Management Plan is provided as a separate document.

Table 3. Odour Management in Design, Commissioning and Operations

Stage in Development	Odour Management Task
Design	Design concepts for odour control
	Design air extraction rates
	Design of covers, seals and bolts
	Sealing bins, sludge hoppers and processing bld.
	Design of ducts (multiple connections)
	Negative pressure sensors
	Scrubbers
	Size of the stack
	Backup and redundancy
	Monitoring sites and equipment
	Odour inventory and modelling
	Compliance with odour criteria
	Specification of design requirements
Commissioning	Scrubber performance testing
	Cover testing (smoke and negative pressure)
	Balancing duct flows and pressures
	Verification of performance
Operations	Standard operating procedures
	Checks of flows and loading
	Continuous H ₂ S monitoring
	Regular odour monitoring
	Replacement of scrubber media Phone and community surveys
	Measures to respond to upset conditions
Operations – contingency plans	Contingency plans for upsets or maintenance
	Contingency plans in the event of exceedances
Monitoring	Complaint registration and response
	Odour surveys – monitor extent of odour impact
	Audit at 3-year intervals
	Reporting and re-design as required

Figure 1 Layout of the Proposed East Rockingham WWTP

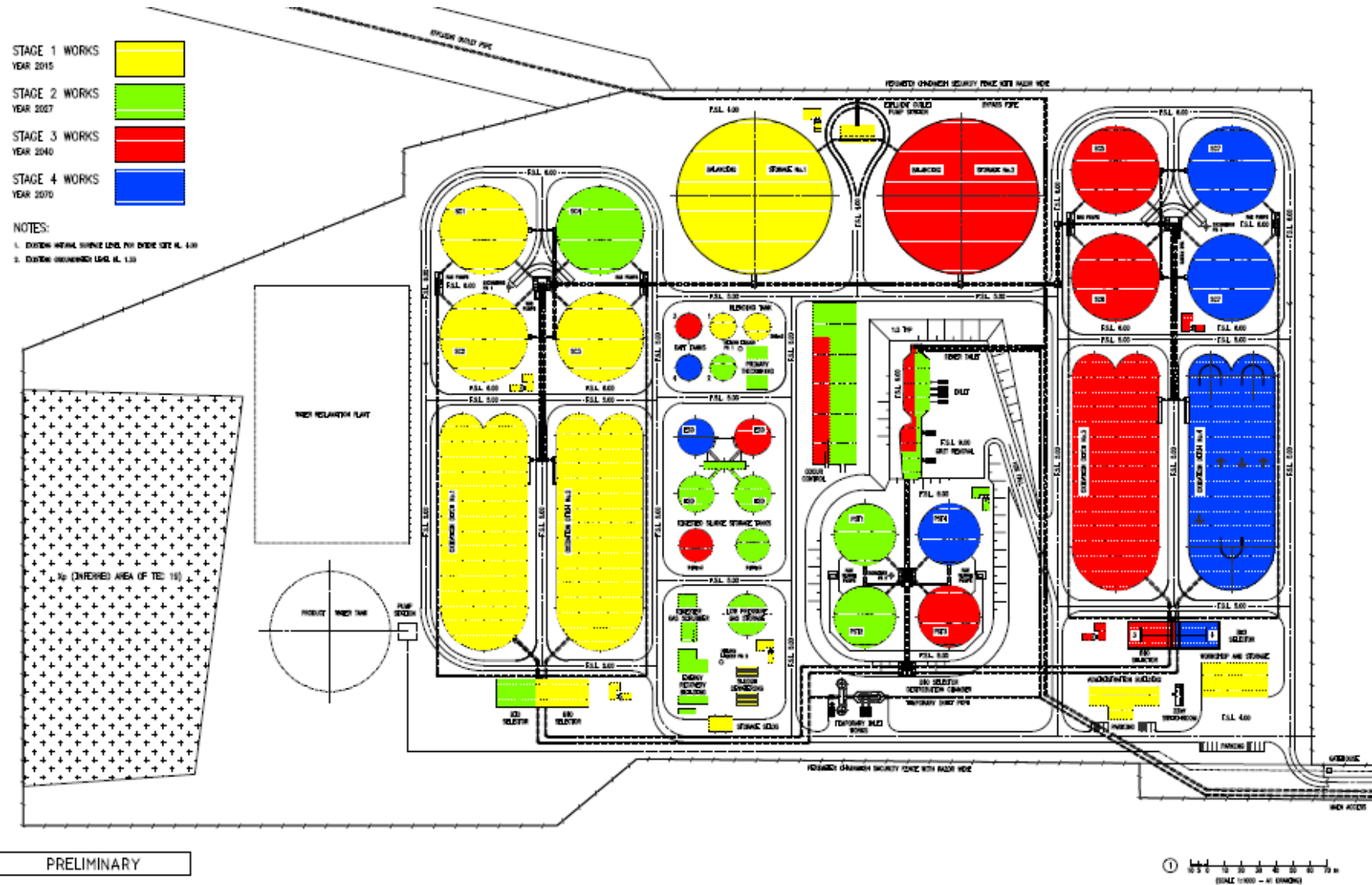


Figure 2. Comparison of Ground Level Odour Emissions in Stages of East Rockingham Plant

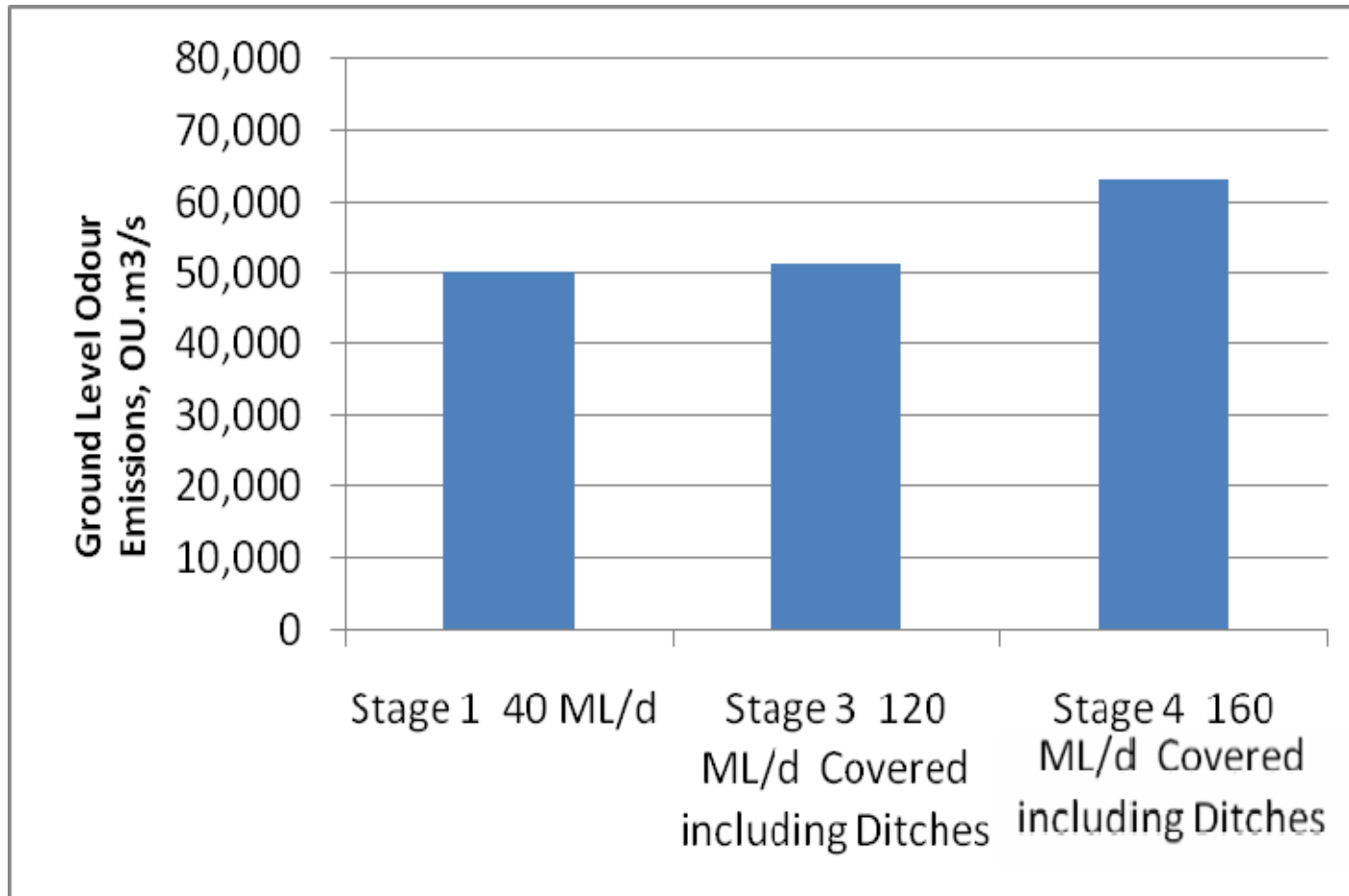
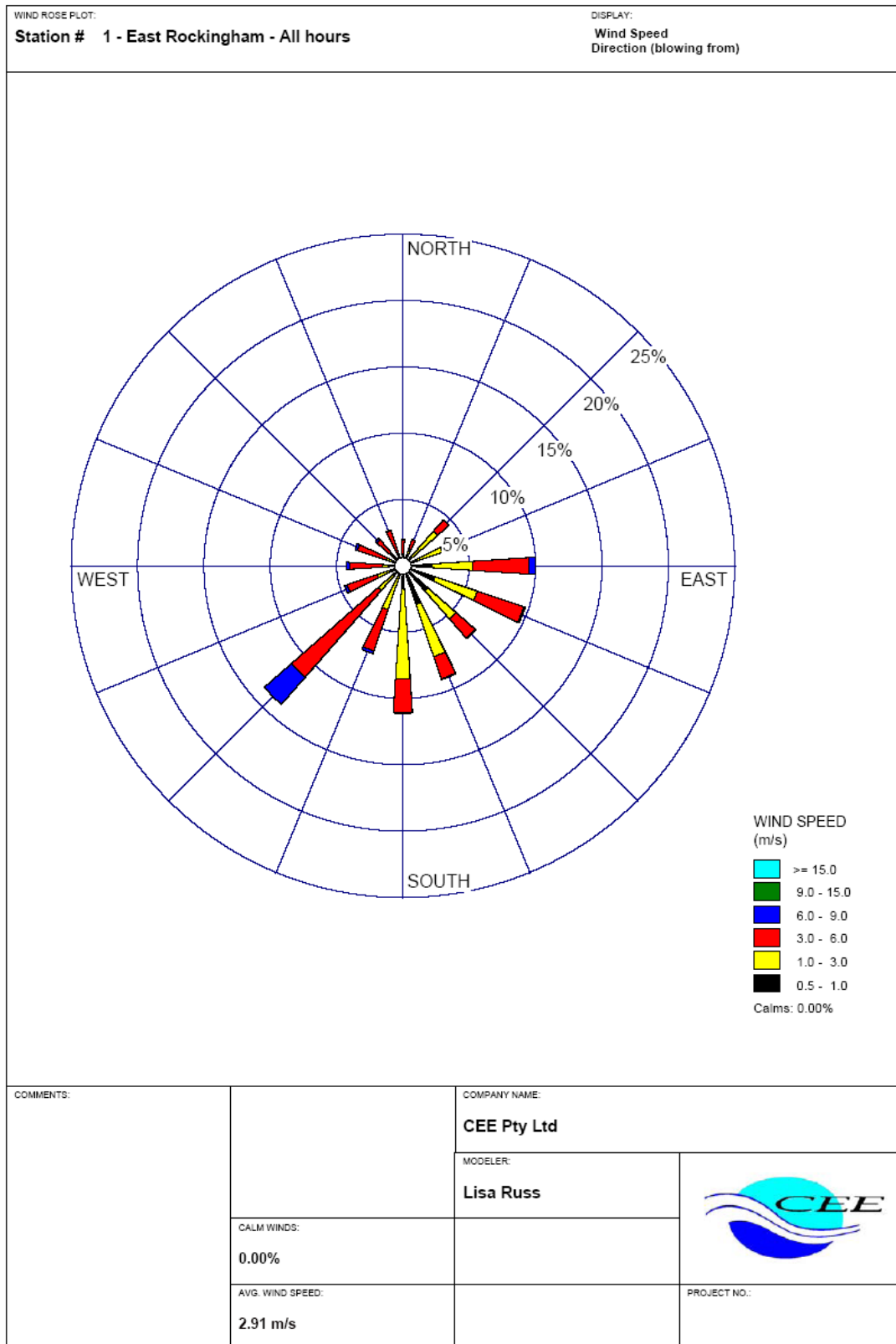
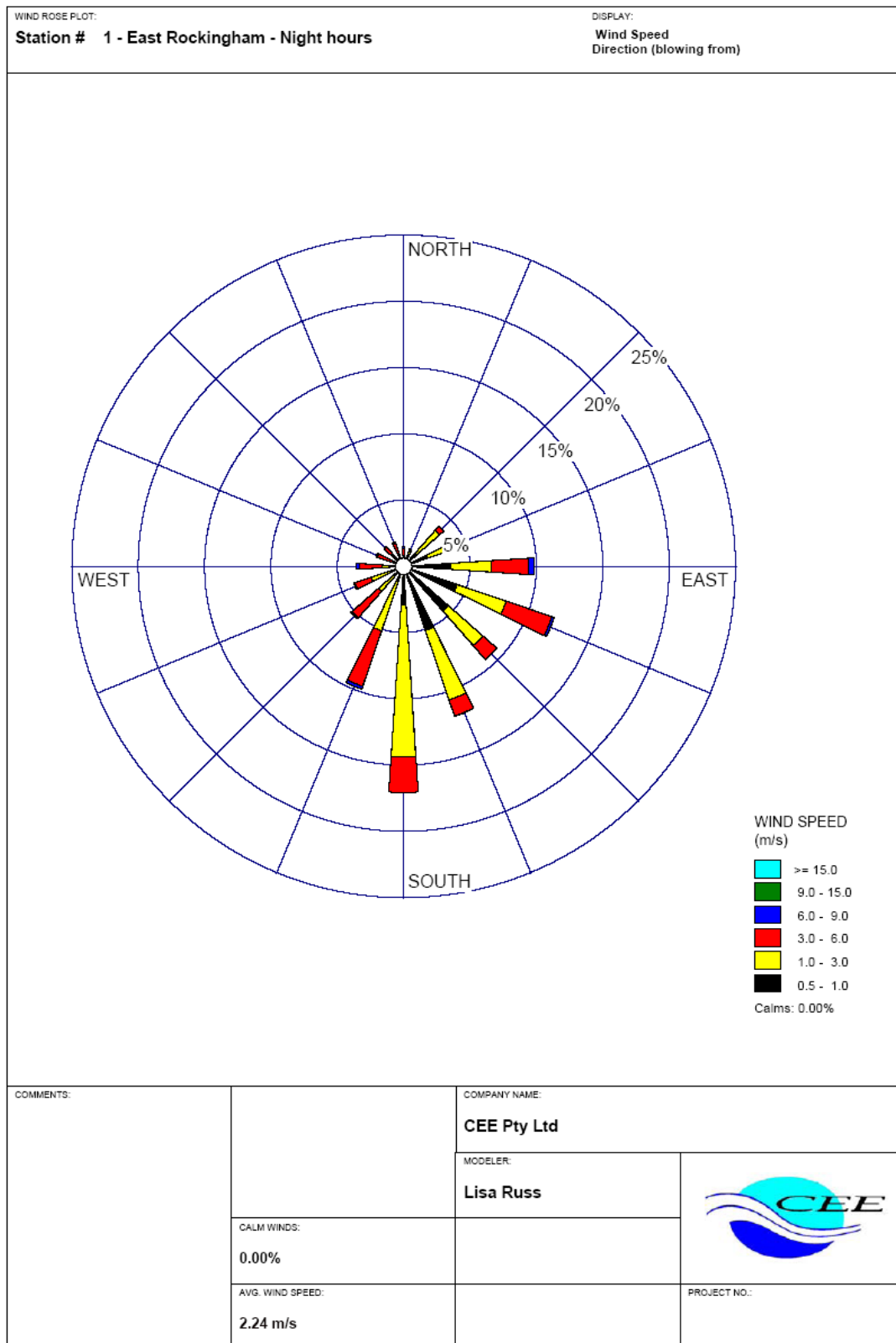


Figure 4. Annual Wind Rose at East Rockingham – All Hours



WRPLOT View - Lakes Environmental Software

Figure 5. Annual Wind Rose at East Rockingham – Night Hours



WRPLOT View - Lakes Environmental Software

Figure 6. Predicted Odour Contours – 40 ML/d Plant

Stage 1 - 40 ML/d Plant (50160 OU. m3/s)

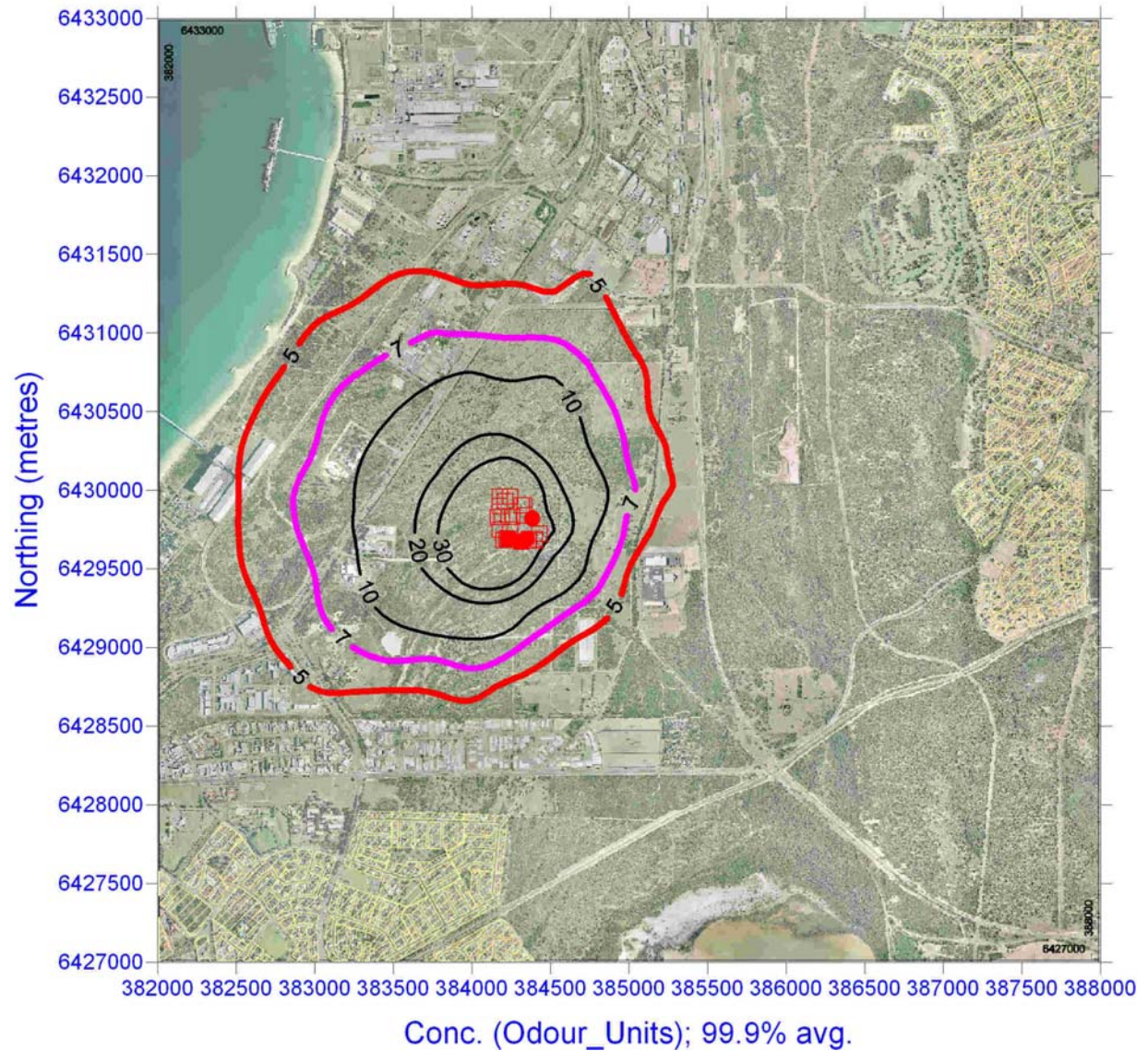


Figure 7. Predicted Odour Contours – 120 ML/d Plant

Stage 3 - 120 ML/d Plant (51080 OU. m3/s)

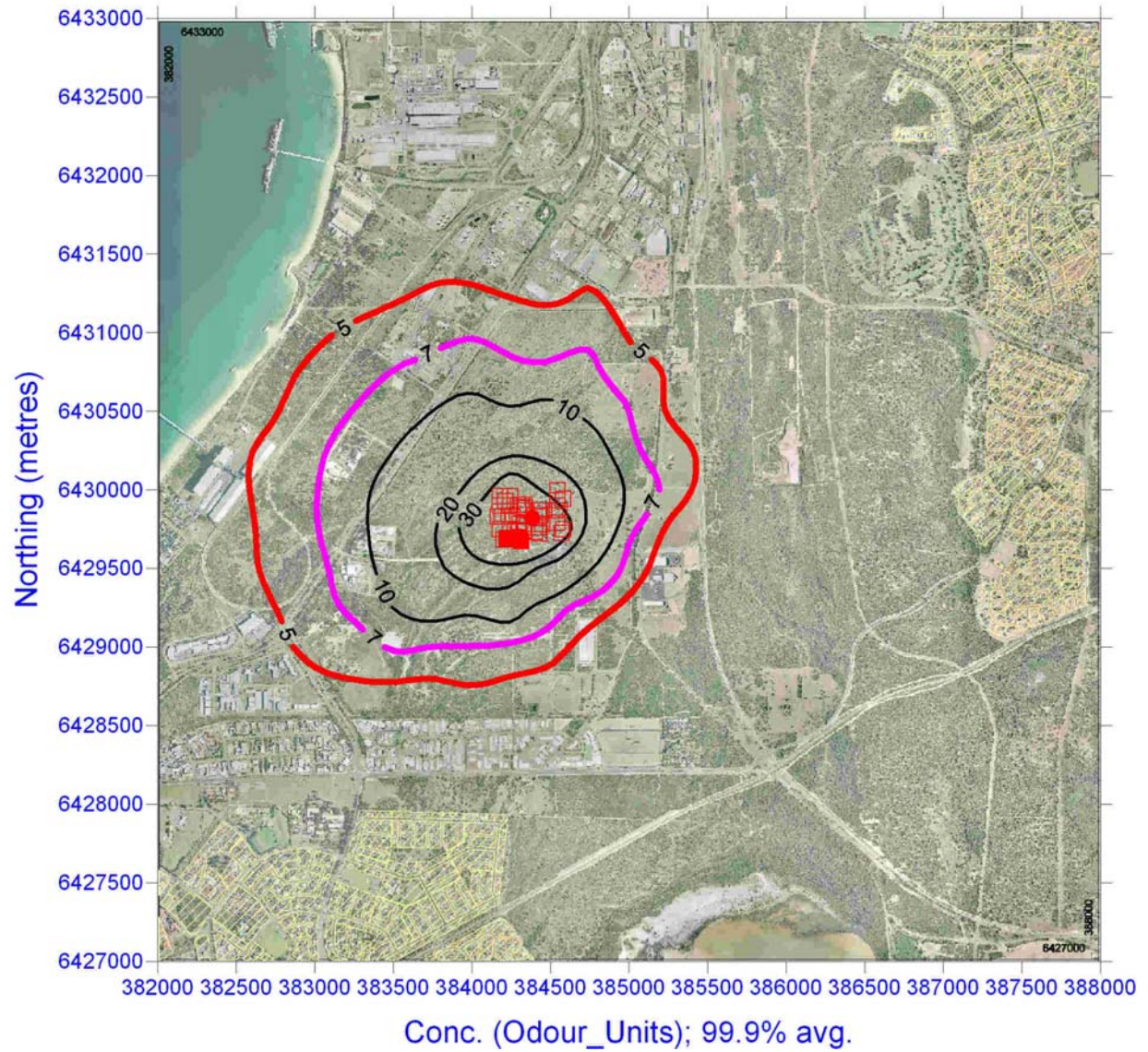


Figure 8. Predicted Odour Contours – 160 ML/d Plant

Stage 4 - 160 ML/d Plant (63050 OU. m3/s)

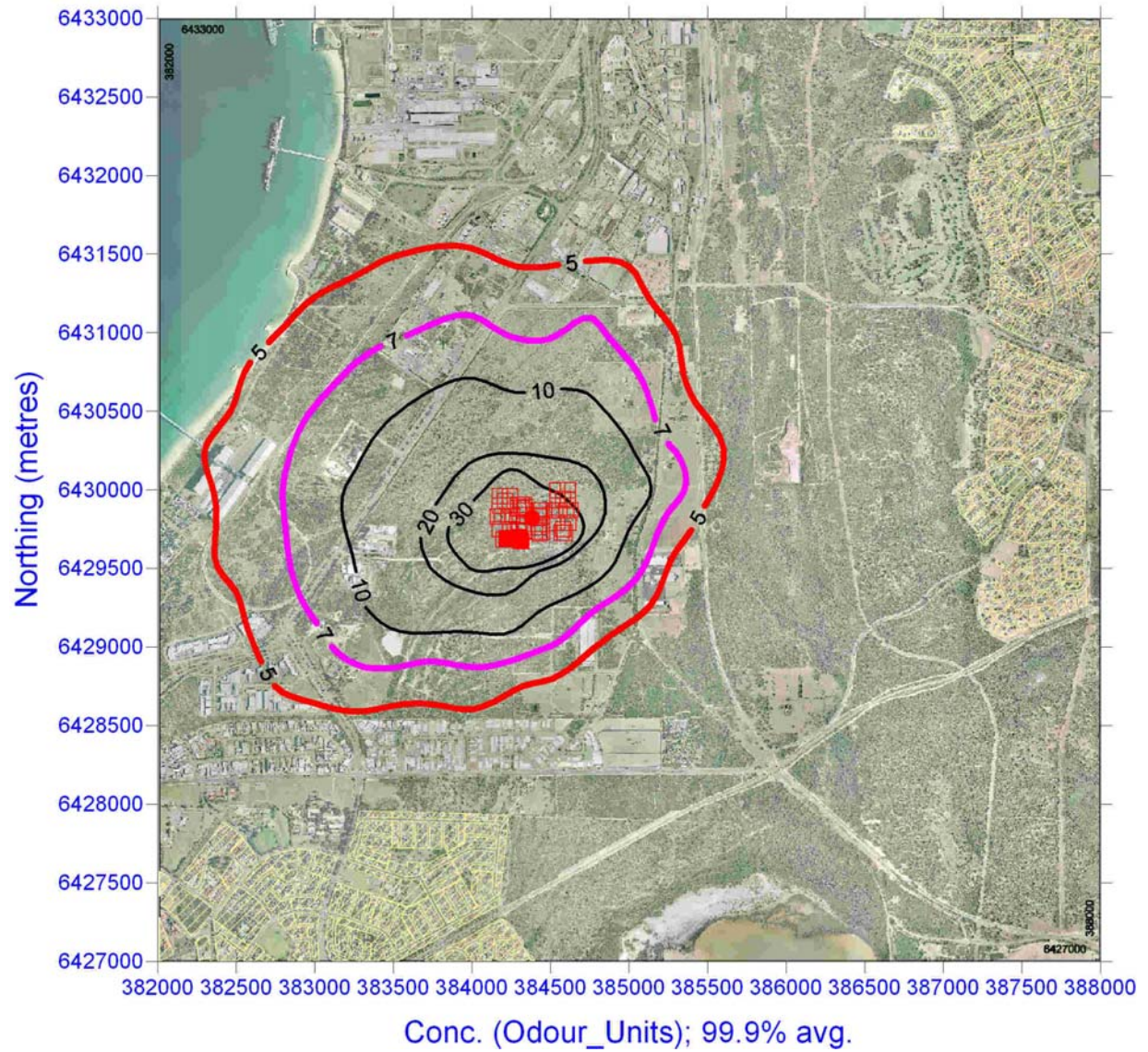


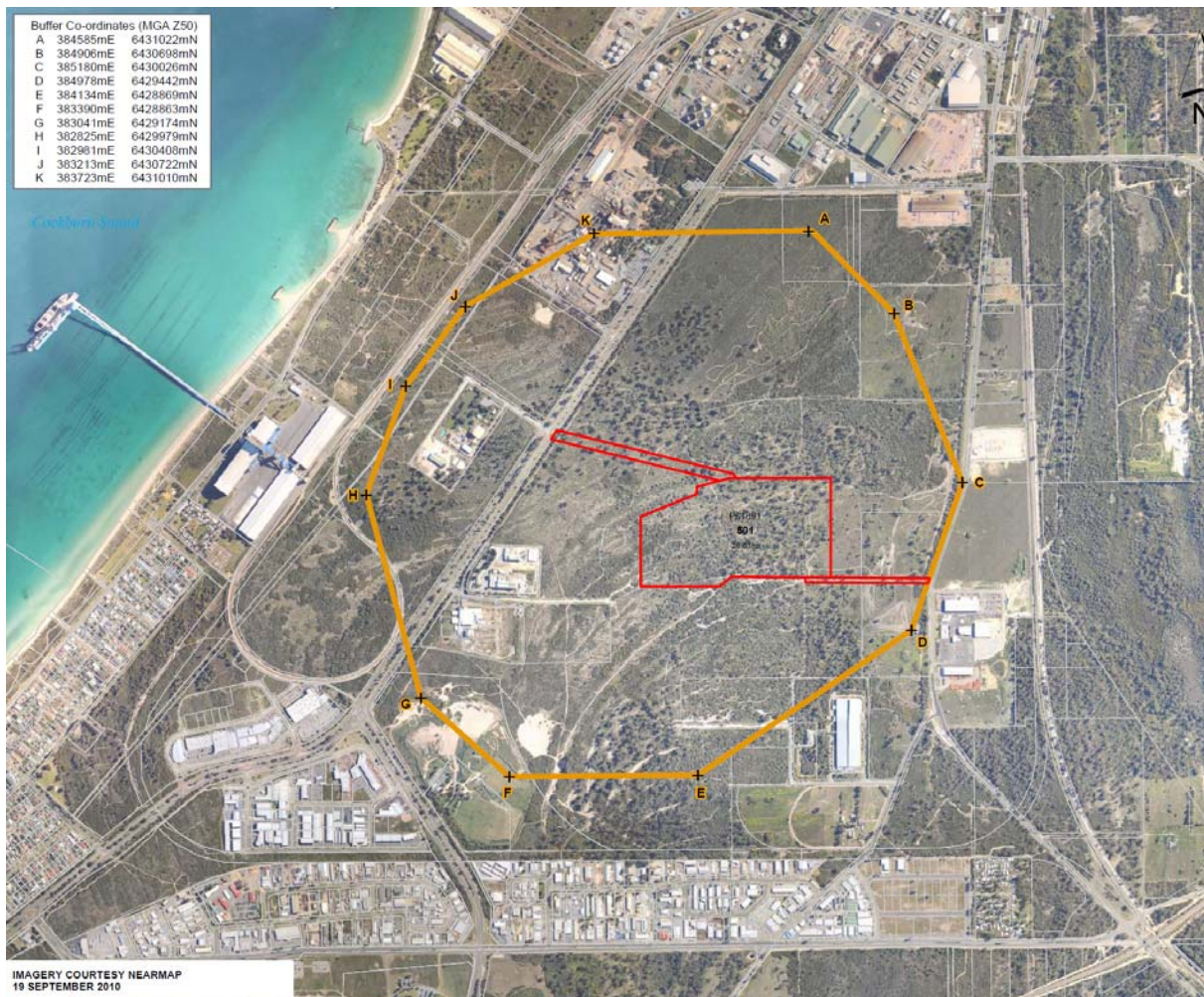
Figure 9. Predicted 7 OU Contour for Stages of East Rockingham WWTP, with Recommended Buffer Zone



Key:

- Green shading: Land zoned industrial west of Mandurah Road
- Yellow shading: Land zoned public open space
- Red line: Predicted 7 OU contour for Stage 1 Plant at 40 ML/d capacity
- Mid-Green line: Predicted 7 OU contour for Stage 2 Plant at 80 ML/d capacity
- Dark blue line: Predicted 7 OU contour for Stage 3 Plant at 120 ML/d capacity
- Dotted purple line: Predicted 7 OU contour for Stage 4 Plant at 160 ML/d capacity
- Thick orange line: Recommended buffer zone for East Rockingham WWTP

Figure 10. Recommended Buffer Zone for East Rockingham Plant



References

K Cadee and I Wallis “Odour Containment and Ventilation at Perth’s Major WWTPs”, Water, pp. 33 – 38, March 2007
 I Wallis and R Oma, “Experience in Odour Management in Western Australia”, Third IWA Conference, Barcelona, 2008.