Odour Management Plan for Alkimos Wastewater Treatment Plant

October 2010

Alkimos Odour Management Plan

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1. Introduction to Odour Management Plan

The objective of the Odour Management Plan is to ensure that the Alkimos WWTP is designed, constructed and operated to manage the potential impacts of odour to within the 600 m buffer zone allocated by the Metropolitan Regional Planning Scheme. This buffer is less than the 800 m zone requested by the Water Corporation to allow development of a full secondary treatment plant with on-site sludge handling at a capacity of 160 ML/d. Thus very careful control of odours will be required at all stages of design and operation of the plant.

The design maximum odour level at the boundary of the buffer zone is 5 odour units (OU) for 99.9 per cent of the time, as proposed by the Water Corporation in the Works Approval Application and set out in Ministerial Condition 12.7 for the development of the Alkimos treatment plant. Keeping odours at the boundary of the buffer zone within this odour limit will ensure that there is no noticeable odour at residences beyond the buffer zone.

A particular feature of the Alkimos site is that the plant is located in a deep excavation (see photo on cover of this document). Temperature and wind patterns create a temperature inversion across the top of the basin on many nights per year. Under such conditions, the air in the excavated basin below the inversion can be considered as a “pond”. During the night hours, fugitive odours will accumulate in the ponded air.

The quickening wind speed and rising temperatures in the morning release the air from the pond, producing a flow of potentially odorous air from the treatment plant over the land to the west and south-west. The effect of ponding is to concentrate the release of odours over a short period in the early morning. Thus control of diffuse odour emissions from all parts of the treatment plant is essential to achieve the objectives of the Water Corporation and keep odours below the threshold of causing nuisance at properties outside the buffer zone.

The requirements for the Odour Management Plan include a description of the odour control measures to be adopted to limit odour releases (covers, odour treatment units and stacks), periodic monitoring during operations, odour modelling, contingency plans and complaint procedures. The Corporation is required to take a pro-active approach to controlling odours, by installing, operating, monitoring and managing the odour control facilities provided. The procedures set out in this Odour Management Plan will be documented in standard operating procedures to be followed in operations and maintenance to keep odour emissions within the levels necessary to meet the objective.

The Odour Management Plan has been developed to manage the potential impacts of odour for Stages 1 and 2 of the Alkimos plant (to 2028) – a new odour management plan would be required for subsequent stages.

A summary of the Odour Management Plan is given in the final section of this document.

2. Scope of Odour Management Plan

Ministerial Condition 12 for the Alkimos WWTP states that:
Prior to commencement of operation, the proponent shall prepare and submit an Odour Management Plan to manage the impacts of odour on health and safety.

The Odour Management Plan shall address:

1. *Initial dynamic olfactory determination (soon after commissioning as part of proving performance of the odour scrubbers);*
2. *Biofilter acclimatisation period;*
3. *Procedures for replacement of scrubber media;*
4. *Regular checks of loading to ensure that flow and loading is balanced and to identify and correct any short circuits;*
5. *Size of the stack;*
6. *Compliance with odour criteria and trigger mechanisms for remedial actions;*
7. *Regular qualitative determination of odour from the facility;*
8. *Odour surveys every five years;*
9. *Contingency plans during upset or maintenance conditions;*
10. *Contingency plans in the event of exceedances;*
11. *Complaint registration, investigation and response.*

In preparing the Plan, the proponent shall consult with the Environmental Protection Authority.

Every requirement is addressed in the Alkimos Odour Management Plan, as outlined in Table 1.

Table 1. Requirements for Odour Management Plan

No	Requirement	Covered in Section
1	Initial olfactory determination	Commissioning - 16
2	Biofilter acclimatisation period	Commissioning – 15
3	Replacement of scrubber media	Operations – 20
4	Checks of flows and loading	Operations – 18
5	Size of the stack	Design – 13
6	Compliance with odour criteria	Design – 11
7	Regular odour monitoring	Operations – 21
8	Odour surveys	Monitoring – 21
9	Contingency plans for upsets or maintenance	Contingency plans – 23
10	Contingency plans in the event of exceedances	Contingency plans – 24
11	Complaint registration and response	Complaints response - 22

3. Development of Odour Management Plan

There are several stages in the development and operation of a wastewater treatment plant and the components of the Odour Management Plan have been 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 in accordance with the Ministerial Condition and the environmental policies of the Water Corporation, are shown below in Table 2.

Table 2. Odour Management in Design, Commissioning and Operations

Stage in Development	Odour Management Task
Design	Concept for odour control
	Design of covers and odour capture
	Odour inventory
	Odour modelling
	Compliance with odour criteria
	Monitoring equipment
	Size of the stack
	Specification of design requirements
Commissioning	Bioscrubber acclimatisation period
	Initial olfactory determination
	Balancing duct flows and pressures
	Verification of performance
Operations	Standard operating procedures
	Checks of flows and loading
	Replacement of scrubber media
	Regular odour monitoring
Operations – contingency plans	Contingency plans for upsets or maintenance
	Contingency plans in the event of exceedances
Monitoring	Complaint registration and response
	Odour surveys
	Reporting and re-design as required

The procedures to be followed according to this Odour Management Plan are summarised for ready reference in Section 26, the final section of this document.

4. Staged Development of Alkimos Plant

It is planned to develop the Alkimos WWTP in several stages so that the increase in plant capacity matches the growth in flows to the plant. Current plans for the stages in development are as follows:

- Stage 1 – 20 ML/d – provides capacity from 2010 to 2018
- Stage 2 – 40 ML/d – provides capacity from 2018 to 2028
- Stage 3 – 80 ML/d – provides capacity from 2028 to 2050
- Stage 4 – 120 ML/d – provides capacity from 2050 on.

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In about 2045, a decision will be made about subsequent expansion of the plant from 80 ML/d to the larger capacity necessary to handle wastewater flows after 2050. The proposed ultimate capacity of the Alkimos WWTP is 160 ML/d which may be reached late in the century.

There are several options to be considered in 2045, including adding primary treatment, which will reduce the loads on the secondary treatment system and allow the plant capacity to be increased to 120 ML/d or more. A second option is to increase the number of secondary treatment units, avoiding primary treatment, to increase the plant capacity to 120 ML/d or more. A third alternative is to introduce membrane filters into the secondary sedimentation tanks to increase the treatment capacity of the secondary treatment units.

Advances in treatment technology over the period to 2045 may create better and more cost-effective treatment options with reduced energy consumption and lower energy use to be adopted. Thus the final capacity and layout of the Alkimos WWTP cannot be defined at this stage.

This Odour Management Plan has been developed to guide the design and operation of the Alkimos plant over Stages 1 and 2 (to 2028) to manage the potential impacts of odour to within the current buffer zone.

Stage 1 – 20 ML/d Capacity – for 2010 to 2018

The layout of the Stage 1 plant is shown in Figure 1. The Stage 1 plant will include the following components:

- Screens – to remove detritus;
- Screenings conveyors;
- Screenings washer – to reduce water content;
- Screenings bins – for transport of screenings from the site;
- Grit tanks – to capture sand and grit;
- Grit conveyors;
- Grit washer – to reduce water content;
- Grit bin – for transport of screenings from the site;
- Bioselector – to ferment organic solids and enhance nitrogen removal;
- Flow distribution – to send equal flow to the three oxidation ditches;
- Oxidation ditches – to provide secondary treatment;
- Secondary sedimentation tanks – to remove and recycle activated sludge;

- Scum pumping – return scum from secondary sedimentation tanks;
- Sludge pumping – return sludge from secondary sedimentation tanks;
- DAF – to thicken sludge for transport;
- Sludge storage – tank to store sludge before transfer to tankers;
- Effluent flow attenuation basin – to even out the rate of effluent discharge;
- Reclaimed water system – to polish, disinfect and distribute reclaimed water.

To achieve cost-effective treatment, the Alkimos plant is being constructed in stages. Particular features of the Stage 1 plant are as follows:

- There will be a temporary inlet works with screens and grit tanks. A new larger inlet works will be constructed as part of the Stage 3 plant.
- There will be three oxidation ditches with a combined capacity of 20 ML/d. All three ditches will be constructed in Stage 1 but initially only two of the tanks will be used, until flows increase and the third ditch is needed.
- Waste activated sludge will be thickened in DAF tanks and stored in a tank of 380 m^3 volume, for transport in tankers away from the site. An onsite sludge dewatering system will be constructed as part of the Stage 2 plant.

Odour control will be incorporated into the design and operation of all components and all stages of the plant, as described in subsequent sections of this Odour Management Plan.

Stage 2 – 40 ML/d Capacity – for 2018 to 2028

The Stage 2 plant will involve the addition of an extra screen, two additional oxidation ditches and two additional secondary sedimentation tanks, as shown in Figure 2.

Stage 3 – 80 ML/d Capacity – for 2028 to 2050

The Stage 3 plant will involve the construction of a new inlet works (screening and grit tanks and related conveyors and storage bins) and the addition of four additional oxidation ditches and four additional secondary sedimentation tanks (in stages as the flow increases). The general layout is shown in Figure 3. Stage 3 also will involve a new sludge handling system expected to include centrifuges to dewater sludge, a dewatered biosolids storage hopper and an enclosed building to load biosolids into trucks.

In view of the proposed new treatment facilities and operating procedures, a new Odour Management Plan will be required for Stage 3.

Stage 4 – 120 ML/d Capacity – for after 2050

The Stage 4 plant will involve the construction of further treatment facilities yet to be defined. These facilities will be selected and designed in thirty years timed, based on the population growth rate in the catchment, technology available at that time and the findings from the Odour Management Plan to that time.

Figure 1 Proposed Stage 1 Plant at Alkimos

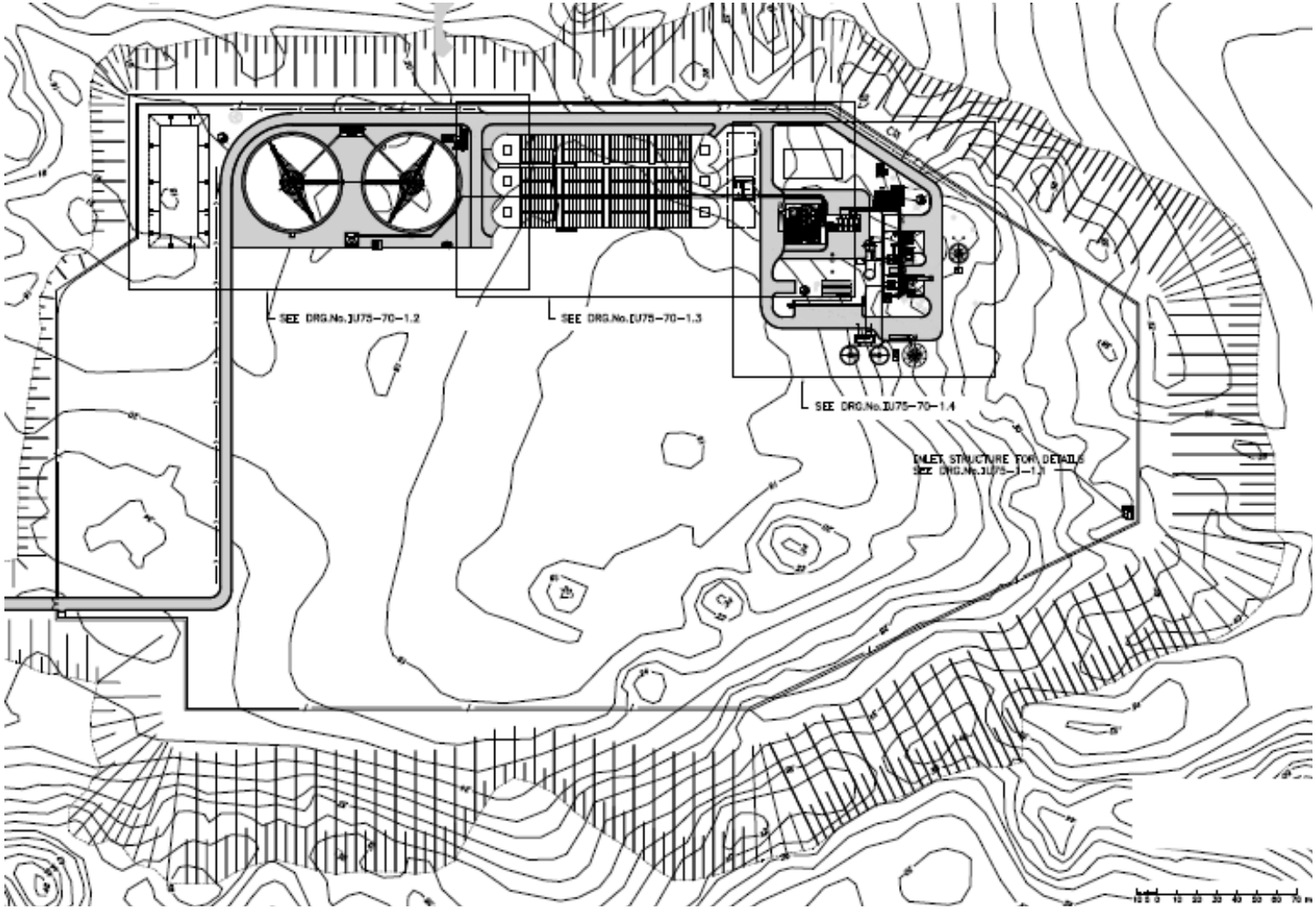
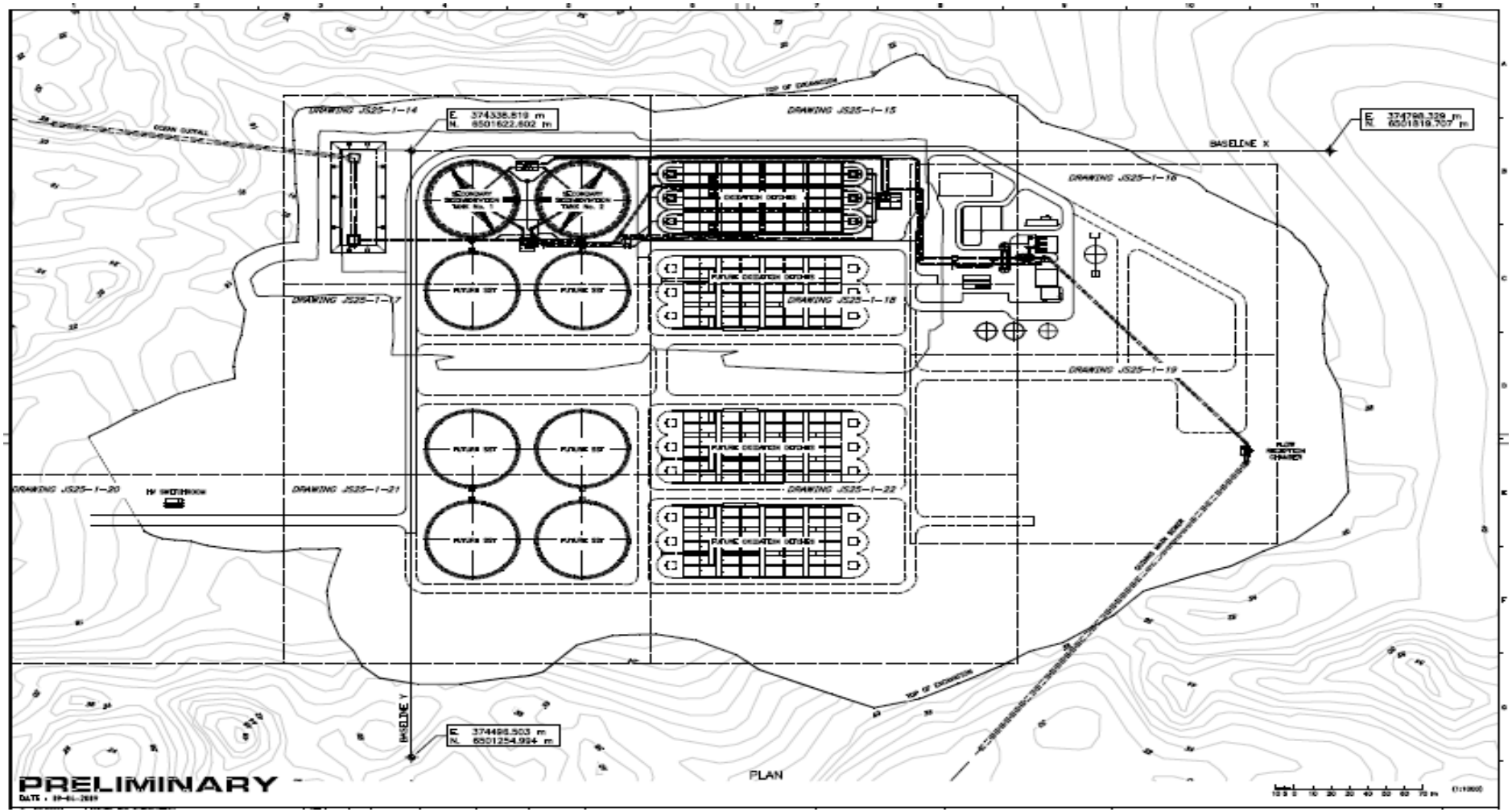


Figure 2 Proposed Stage 2 and Stage 3 Plant at Alkimos


PRELIMINARY
PLAN
BASELINE X
BASELINE Y
DRAWING JS25-1-14
DRAWING JS25-1-15
DRAWING JS25-1-16
DRAWING JS25-1-17
DRAWING JS25-1-18
DRAWING JS25-1-19
DRAWING JS25-1-20
DRAWING JS25-1-21
DRAWING JS25-1-22
FUTURE SST
FUTURE DECANTER DITCHES

5. Stages 1 and 2 – Concepts for Odour Control

All treatment units that could be a source of odour will be covered in Stages 1 and 2. A separate odour control system will be provided for the higher strength odour sources (inlet works, bioselector, flow separation tank, sludge storage) and a separate system for the lower strength odour sources (oxidation ditches, scum pumping, sludge pumping).

Foul air containing the higher strength odour will be treated in photo-ionisation units (essentially UV lamps followed by activated carbon). Provision has been made in the layout to add bioscrubbers ahead of the photo-ionisation units in the event that the consumption of power or activated carbon is high and pre-treatment of the odours in bioscrubbers will provide a more reliable or economical solution. The scrubbed air from the odour treatment units will be discharged through a 50 m high stack.

Foul air containing the lower strength odour initially will be discharged through the stack without scrubbing. This air will come from the oxidation ditches. The odour level in this air stream is expected to be relatively low and therefore not require scrubbing before discharge from the stack.

However, the layout can be modified to allow for odour treatment before the stack (for example the installation of biocrubbers or another type of scrubber) in the event that odour from the oxidation ditches is higher than expected.

Effective control of odours requires careful control of all aspects of the design, operation and maintenance of covers, ducts and odour treatment units to minimise the release of fugitive odours. The procedures to be followed are described in the following sections of this Odour Management Plan.

6. Design – Odour Control for Preliminary Treatment

The odour control system for the preliminary treatment area has been designed to achieve a very high capture of odours by fully covering and enclosing all tanks, conveyors, handling equipment and bins. The design target is set in terms of:

- Achieving a negative pressure under the covers of -15 Pa or better;
- Ensuring foul air is removed from all parts of channels, tanks and equipment (generally managed by appropriate location of air inlets and extraction points, and removing sufficient foul air to provide between 12 and 30 air changes per hour, depending on the type of source).

Applying these principles, the calculated air extraction rates from the preliminary treatment area of Stages 1 and 2 of the Alkimos plant are as listed in Table 3.

Table 3. Air Extraction Rates in Stages 1 and 2 of Alkimos Plant

Odour Source,	Extraction Rate, m^3/hr (Stage 1)	Extraction Rate, m^3/hr (Stage 2)
Inlet sewer	2,500	5,000
Screens and bins	7,500	7,500
Grit tanks	900	1,800
Bioselectors	1,200	2,400
DAF tanks	300	600
Sludge storage tank	2,500	2,700
Combined stream	**15,000**	**20,000**
Oxidation ditch	90,000	180,000
Total to stack	**105,000**	**200,000**

Design requirements for odour control in the preliminary treatment area are summarised below.

1. All tanks and channels to be fully covered with appropriate corrosion-resistant covers specifically designed to capture odours;
2. Seals for covers to have flexible gaskets at least 30 mm wide;
3. Covers to be bolted at close spacing to achieve an air-tight seal;
4. All equipment and bins to be fully sealed with ducts to remove foul air;
5. Air extraction rates for tanks and equipment to meet Water Corporation best practice guidelines);
6. Negative pressure sensors in tanks and ducts, connected to SCADA system. Design negative pressure of – 15 Pa or better;
7. Sufficient connection points for ducts on each tank to avoid dead zones;
8. Measurement and monitoring points, and related equipment, to be provided on ducts and before and after odour treatment systems. Standard measurement station (for flow and H2S concentration) just before stack. Condensate drainage and monitoring points installed on ducts.

7. Design – Odour Control for Secondary Treatment

The odour control system for the secondary treatment area has been designed to achieve a very high capture of odours by fully covering and enclosing the oxidation ditches, mixed liquor channels, scum pit and return sludge pit. No covers are proposed on the secondary sedimentation tanks and splitting chamber as experience at other plants has shown that these are only minor sources of odour. However launders on the secondary sedimentation tanks will be covered to limit algal growth and this will have a secondary benefit of slightly reducing odour emissions from the launders.

The design target is set in terms of:

- Achieving a negative pressure under the covers of -15 Pa or better;
- Ensuring foul air is removed from sufficient points on each oxidation ditch to avoid dead zones (by appropriate location of air extraction points);
- Removing sufficient foul air (to provide 10 air changes per hour);
- Achieving an air velocity of 1.5 m/s or more at air inlets.

Applying these principles, the calculated air extraction rates from the secondary treatment area of Stages 1 and 2 of the Alkimos plant are as listed in Table 3..

Note that the air quantities listed in Table 3 are based on the use of mechanical aerators in the Stage 1 and Stage 2 ditches. If the Corporation finds there are benefits, in terms of odour management, power consumption and operations, to replace the mechanical aerators by a diffused air system, this will be done at Stage 2. Current planning is to install a diffused air system in all oxidation ditches in Stage 3, when the use of a shared blower system becomes more economical. The air extraction rate from the oxidation ditches will then reduce to 10,000 m^3/hr per ditch.

Design requirements for odour control in the secondary treatment area are summarised below.

1. All oxidation ditch tanks and channels to be fully covered with appropriate corrosion-resistant covers specifically designed to capture odours;
2. Seals for covers to have flexible gaskets least 30 mm wide;
3. Covers to be bolted at close spacing to achieve an air-tight seal ;
4. Velocity at air inlets to be 1.5 m/s or more;
5. Air extraction rate to be capable of 30,000 m^3/hr from each of the Stage 1 oxidation ditches;
6. Negative pressure sensors in tanks, connected to SCADA system. Design negative pressure of – 15 Pa or better;
7. Sufficient connection points for ducts on each tank to avoid dead zones;
8. Measurement and monitoring points and equipment installed on ducts;
9. No air path between ditches so that any ditch can be taken out of service for maintenance without affecting the odour capture system.

The basis for design of odour control systems at wastewater treatment plants is set out in the papers by Cadee and Wallis (2007) and Wallis and Oma (2010). The first paper shows that a minimum velocity of 1.5 m/s at air inlets to covers and a pressure of - 15 Pa corresponds to a high efficiency of odour capture by the covers.

8. Design – Odour Control for Sludge Handling

In Stages 1 and 2, the sludge handling system will comprise DAF (dissolved air flotation) tanks to thicken the waste activated sludge and a thickened sludge storage tank.

At Stage 3, a new sludge handling system will be added to dewater sludge on the site. This is expected to comprise centrifuges to dewater sludge, a dewatered biosolids storage hopper and an enclosed building to load biosolids into trucks.

At Stage 4 it is possible that primary treatment tanks and digesters may be introduced, but this will depend on the findings of odour monitoring during the Stage 3 operations. Primary treatment and digestion would add significantly to the odour emissions from the plant, as they will introduce anaerobic treatment to the site.

The odour control system for the sludge handling system in all stages will be designed to achieve a very high capture of odours by fully covering and enclosing all units that are processing or storing sludge.

For Stages 1 and 2, the DAF tanks and sludge storage tank will be covered and air extracted and taken to the odour treatment units. The design target is set in terms of:

- Achieving a negative pressure under the covers of -15 Pa or better;
- Ensuring foul air is removed from multiple points on each tank;
- Removing sufficient foul air to provide 10 air changes per hour in the sludge storage tank and at least 5 air changes per hour in the DAF.

Applying these principles, the calculated air extraction rates from the secondary treatment area of Stages 1 and 2 of the Alkimos plant are as listed in Table 3..

Additional design requirements for odour control in the sludge area are summarised below.

1. All tanks to be fully covered with appropriate corrosion-resistant covers specifically designed to capture odours;
2. Seals for covers to have flexible gaskets least 30 mm wide;
3. Covers to be bolted at close spacing to achieve an air-tight seal ;
4. Air extraction rates for tanks and equipment in accordance with Water Corporation best practice guidelines;
5. Negative pressure sensors in sludge storage and DAF tanks connected to the SCADA system. Design negative pressure of – 15 Pa or better;
6. Sufficient duct connection points on each tank to avoid dead zones;
7. Measurement and monitoring points and equipment installed on ducts.

9. Design – Odour Treatment Units

The foul air from the inlet area, bioselectors and sludge handling areas will have a high odour level and hence will be treated in photo-ionisation units (essentially UV lamps followed by activated carbon). The layout of the photo-ionisation units is shown in Figure 3. The scrubbed air from the odour treatment units will be ducted for discharge through a 50 m high stack.

Foul air from the oxidation ditches containing the lower strength odour initially will be ducted directly to the stack. The odour level in this air stream are relatively low and therefore do not require scrubbing before discharge from the stack. Provision has been made to modify the layout and add bioscrubbers (or other odour treatment units) ahead of the stack so that if the odour level is higher than expected, the odours can be substantially reduced by the bioscrubbers before discharge.

A flow measurement station in accordance with AS4143 will be installed ahead of the stack. This will have four ports offset at 90 degrees to allow manual measurement of air velocity and sampling of constituents in the air stream.

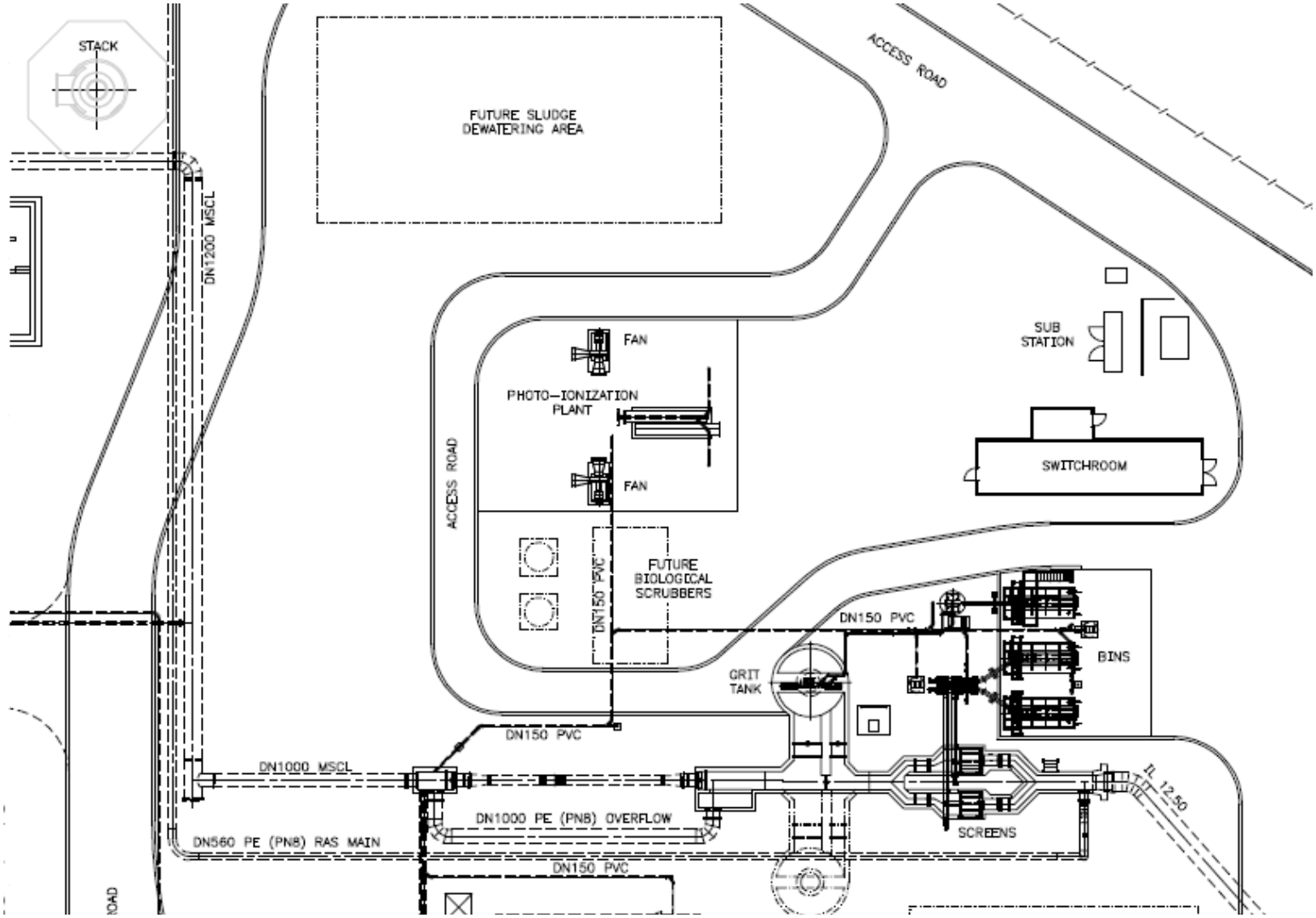
Four H_2S analysers will be installed and continuously operated. These will be:

1. Upstream of the Photo-ionisation Plant (such as Draeger Polytron or simular);
2. Downstream of the Photo-ionisation Plant (such as MDA Scientific Chemcassette or simular);
3. On the duct from the oxidation ditch area (such as Draeger Polytron or simular); and
4. Before the stack at the measurement station (such as MDA Scientific Chemcassette or simular).

Design requirements for the odour treatment units are summarised below.

1. All air extracted to be treated, with no bypassing. (Note that air extracted from oxidation ditches will not be treated if it has a low odour level without treatment);
2. Discharge odour from photo-ionisation unit to be less than 800 ou for 99 % of the time;
3. Redundancy to be provided, with a target availability for the odour treatment system of 99.9 % of the year (including a backup bioscrubber if installed).
4. Major maintenance to be carried out on non-operating unit with remaining units operating;
5. Continuous measurement of H2S before and after odour treatment units with SCADA logging of results;
6. Continuous measurement of air flow rate and temperature before and after odour treatment units;
7. Measurement and monitoring points installed on ducts for manual sampling, and flow measurement and balancing. Regular monitoring at these points is prescribed in Section 21.

Figure 3 Layout of Proposed Stage 1 Odour Treatment Units at Alkimos



10. Design – Commitment to Additional Odour Treatment

As noted above, provision has been made in the layout to add bioscrubbers (or other odour treatment units) ahead of the photo-ionisation units and also to scrub the discharge from the oxidation ditches. A backup bioscrubber would be provided in each group of odour treatment units to achieve the required level of backup and availability.

Figures 4 and 5 show the predicted odour contours for Stage 1 of the Alkimos plant with fugitive emissions controlled by covers (as described in previous sections) and the following net odour emission concentrations in the discharge from the stack:

- Figure 4 – stack discharge has odour concentration of 2,400 ou
- Figure 5 – stack discharge has odour concentration of 4,800 ou.

The procedure and wind files used in odour modelling are described in a later section. The predicted odour contours are plotted on a cadastral base map where proposed residential areas are shown in pink, open space is shown in green, commercial areas are shown in blue and the 600 m wide buffer zone for the Alkimos plant is shown in yellow and orange. The existing excavation for the plant is shown as a red polygon. The Stage 1 plant is shown as a series of small red squares in the northern section of the site and the stack as a solid red circle. A 1 km north/east grid is drawn over the base map.

It can be seen in Figure 4 that with the lower odour concentration in the stack discharge (2,400 ou), the predicted 5 ou contour (shown as the dotted red line) extends about 300 m from the boundary of the plant, but is well within the buffer zone.

It can be seen in Figure 5 that with the higher odour concentration in the stack discharge (4,800 ou), the predicted 5 ou contour (shown as the dotted red line) extends about 500 m from the boundary of the plant, close to the western edge, but still within the buffer zone. Given the uncertainties, the maximum allowable odour concentration in the stack discharge for Stage 1 is set at 4,800 ou.

If the odour concentration in the stack discharge exceeds 4,800 ou for an appreciable period (consistently for more than a week), it will mean the odour concentration in the combined flow to the stack (which will mostly be air extracted from the oxidation ditches) is much higher than anticipated. In that event, the Corporation will install odour treatment (eg, bioscrubbers) to scrub the flow from the secondary treatment area. The bioscrubbers will be designed to achieve a discharge odour concentration of less than 4,000 ou for the combined discharge from the stack for 99 % of the time (to provide a factor of safety in regard to the limiting odour concentration of 4,800 ou).
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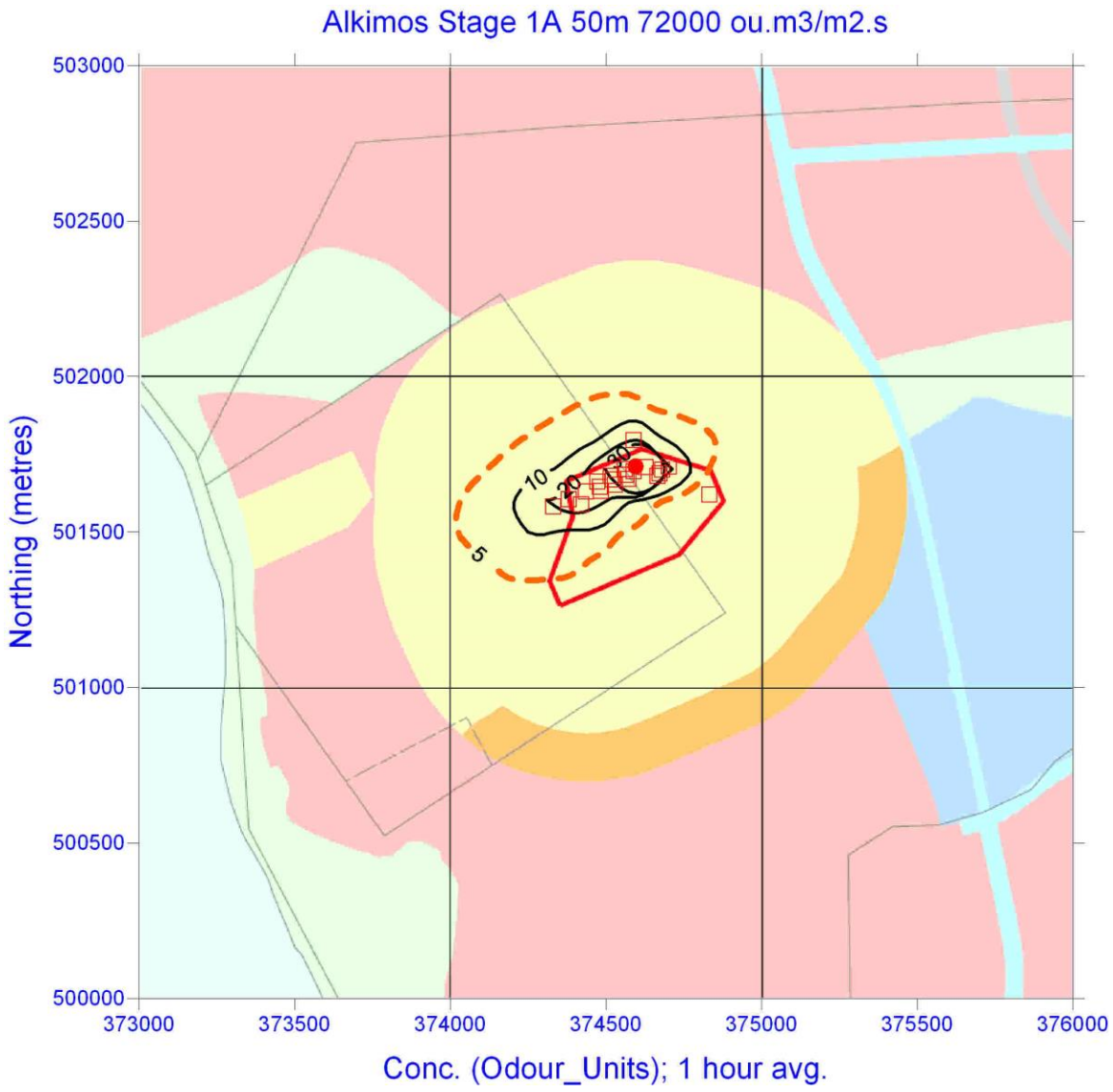
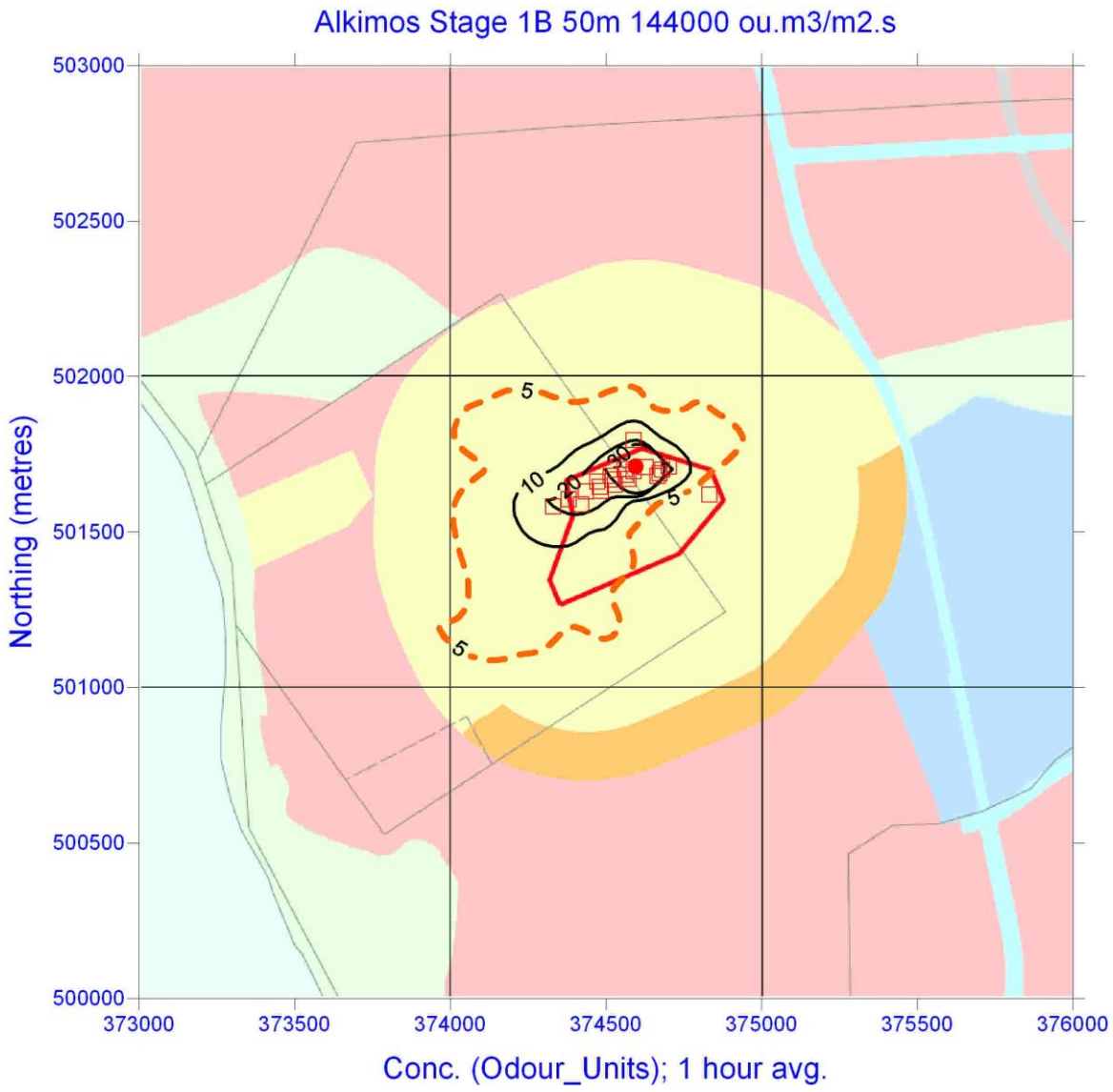
Figure 4 Predicted Odour Contours- Stage 1 – Stack at 2,400 ou



Source: CEE, *"Odour Modelling for Alkimos WWTP"*, Report to Water Corporation, 2010

Figure 5 Predicted Odour Contours- Stage 1 – Stack at 4,800 ou



Source: CEE, *"Odour Modelling for Alkimos WWTP"*, Report to Water Corporation, 2010

11. Design – Odour Modelling

Odour modelling has been carried out to provide a basis to prepare the Odour Management Plan based on the concept designs for the plant. The odour modelling was carried out in accordance with the *EPA's Interim Guidance on Odour as a Relevant Environmental Factor* and the *Air Quality Modelling Guidance Notes (2006)* issued by the DEC.

The following procedure was used:

- WWTP geometry from concept plans of the existing site.
- Odour emission rates as listed in Table 4;
- Meteorological file from measurements at the valley site at Alkimos;
- Ausplume Model version 6 as issued by the Victorian EPA;
- Topography as shown in Figure 6; and
- 60-minute averaging time.

The odour model has been used to predict 99.9 percentile odour contours in the vicinity of the plant. As explained above, the 99.9 percentile predictions represent the odour level that is exceeded for 8 hours per year at each location.

Estimated Odour Emission Rates

Odour emission rates were estimated for the area sources based on odour emission measurements made on similar process units at Albany, Beenyup, Broome, Geraldton and Mandurah. The estimates of odour emission rates are summarised in Table 3.

The emissions from area sources represent the odour emission rate per unit area multiplied by the area of the process tanks. The estimated stack emissions are based on the air discharge rate and an odour concentration of 2,400 ou in the combined air flow from the scrubbers and the oxidation ditches.

Table 4. Estimated Odour Emissions from Alkimos WWTP

Treatment Unit	Odour emission rate, ou.$m^3/m^2.s$	Stage 1 odour emission, ou.m^3/s	Stage 2 odour emission, ou.m^3/s
Inlet Area	2 – 4	800	1,000
Secondary Area	0.6	5,000	10,000
Sludge Handling	1 – 2	400	500
Ground level sources		**6,200**	**11,500**
Stack	2,400 ou	72,000	140,000
Total for plant		**78,500**	**151,500**

The odour emission rate for the inlet area (screening and grit removal) is estimated to be in the range of 2 to 4 ou.$m^3/m^2/s$, depending on the process considered. This corresponds to fugitive emissions from sources with good covers and a high rate of

extraction of air from beneath the covers. The measured odour emission rate from the existing inlet area at Woodman Point and Beenyup WWTP's (after the odour upgrades) range from 3 to 5 ou.m^3/m^2.s. The new inlet at Woodman Point is expected to achieve an odour emission rate of 3 to 4 ou.m^3/m^2.s. Thus the estimated values for Alkimos correspond to current best practice.

The fugitive odour emission rate for the oxidation ditches area (which will be covered) is assumed to be 0.6 ou.m^3/m^2.s. This is a conservative assumption based on measurements made on the existing (uncovered) oxidation ditches at the Mandurah plants which show odour emission rates of 0.5 to 1.5 ou.m^3/m^2.s.

There is some uncertainty about the odour level in the air drawn from the oxidation ditch (no measurements could be found of actual odour levels in a comparable situation) and thus a conservative estimate was made of the possible fugitive emissions. It is important that, as part of the commissioning stage, measurements are made of the odour levels in the duct leading from the oxidation ditch and in fugitive emissions, and the modelling repeated.

The fugitive odour emission rate for the sludge handling processes (DAF tanks and sludge storage tanks) is estimated to be in the range of 1 to 2 ou.m^3/m^2.s, depending on the process considered. This corresponds to fugitive emissions from covered tanks at the Beenyup and Woodman Point plants, with a reasonable rate of air extraction from beneath the covers.

Recent measurements of fugitive odour emission rates at Woodman Point WWTP are presented in Appendix F. These measurements show higher odour emission rates than adopted for the Alkimos odour modelling, as Woodman Point is an existing plant that has been retro-fitted with odour covers while Alkimos is a new plant that has been purpose-built for odour control.

Appendix D provides an odour balance for the odour scrubbers and the stack showing the expected conditions in the Stage 1 Alkimos WWTP.

Appendix E provides a description of the covers, ducts, scrubbers and discharge stack provided at the Alkimos WWTP. The estimates of fugitive odour emissions are based on the functional design description as set out in the document.

It can be seen that fugitive emissions from the Stage 1 and Stage 2 plants are relatively small. Odour emissions from the stack appear to be relatively large, but it should be recognized that the stack has a large air discharge rate at a relatively low odour concentration.

Meteorological Data

The Water Corporation installed two wind monitoring stations (valley site and hill site) and one meteorological monitoring station at the site. Monitoring commenced in 2001 and continued to 2006.

The equipment installed at the Alkimos monitoring stations measured:

- Wind speed and wind direction at 10 m above the ground;
- Air temperature at 2 m and 10 m above the ground;
- Solar radiation; and
- Sigma theta of wind direction variations.

Wind direction, wind speed and air temperature were recorded at 10 minute intervals. The meteorological files were prepared from the wind, temperature and solar radiation measurements using the stability classification criteria published by the Victorian EPA (*Plume Calculation Procedure, 1985*).

Wind and dispersion conditions for predicting odour levels in the area surrounding the Alkimos plant were based on wind and meteorological measurements at the valley site. The valley wind monitoring site was selected for odour modelling as it was less exposed than the hill wind monitoring site and had lower wind speeds.

The winds at the valley site are considered representative of the winds within the excavated basin at Alkimos. However, higher speed winds would normally occur on the land in the buffer zone and beyond, as that land is at a higher elevation. Thus use of the measured valley winds for odour modelling is a conservative approach.

Odour Prediction Model

The *Ausplume* model was used to predict odour contours. The Ausplume model provides a reasonably conservative prediction of odour levels in the area beyond the buffer zone in the absence of ponding. A study[1] of mixing patterns at the Alkimos site (CEE, 2006) was carried out by CEE in cooperation with the CSIRO (the report is provided in Appendix A).

As the Alkimos plant is in a deep basin, there is a concern that odour could accumulate within the basin on nights when there is a strong inversion over the top of the basin. At such times, the rate of replacement of the air inside the basin is reduced, so odour accumulates in the air within the basin, below the inversion level. Thus the odour concentration increases in the “pond” of air within the basin.

Odour will accumulate within the pond until the inversion layer is eroded by an increase in the wind speed or the rising of the sun. The concentrated odour within the pond will then escape, creating a plume with high odour concentrations extending downwind from the basin. After about an hour, the enhanced flushing clears away the accumulated odour within the pond and the ponding event is finished.

[1] **Consulting Environmental Engineers** “Report on Buffer Zone for Proposed Future Alkimos Wastewater Treatment Plant, Incorporating CSIRO Reports on Alkimos Ponding”, July 2006

CSIRO examined the records of meteorological data collected over two years at Alkimos to assess the number of ponding events. In the year, there were about 10 major ponding events, each lasting several hours, 10 moderate events and more minor or negligible events.

CSIRO developed a model of the accumulation of odour in the basin. In summary, ponding over a significant period allows the odour concentration in the basin to increase to about three times the concentration that would occur without ponding.

From a comparison of predicted odour concentrations predicted using the *Ausplume* model, it was found that the peak concentrations with ponding at sites 500 m to 1,500 m downwind are about twice those without ponding.

It is considered that the effects of ponding will be smaller with the Stage 1 plant because it occupies only a small proportion of the basin, allowing a much greater dilution of fugitive odour emissions with the air inside the basin. This can be checked when the Stage 1 plant is in operation.

Odour modelling will be repeated when the plant has been commissioned and more precise estimates of the odour levels in fugitive emissions and in the stack discharge are available. The modelling will use the Ausplume model (as before) and take account of ponding effects as observed in the actual operation of the plant.

12. Design – Compliance with Odour Criteria

The extent of potential odour nuisance is indicated by the 5 ou contour, where this contour is calculated by the Ausplume model, using a 1-hour averaging period at 99.9 percentile frequency. The Corporation has ascertained that the **5 ou** level of odour encompasses the zone of odour complaints from the urban community and also the zone in which odour can be perceived as annoying, based on correlation of odour complaints and odour modelling around the existing Halls Head, Broome, Subiaco, Mandurah, Woodman Point and Beenyup treatment plants. This criterion has recently been endorsed by the EPA in determining an acceptable level of odour for sensitive land uses (EPA Bulletin 1272, October 2007).

The compliance criteria are as follows:

1. Negligible complaints about odour (ideally zero complaints). In this respect, it is noted that no odour complaints have been received concerning odours from the Subiaco plant in the last two years.
2. In phone surveys, the surrounding community do not report a significant increase in odour nuisance above background. This indicates that local amenity is not affected by the operation of the Alkimos plant.

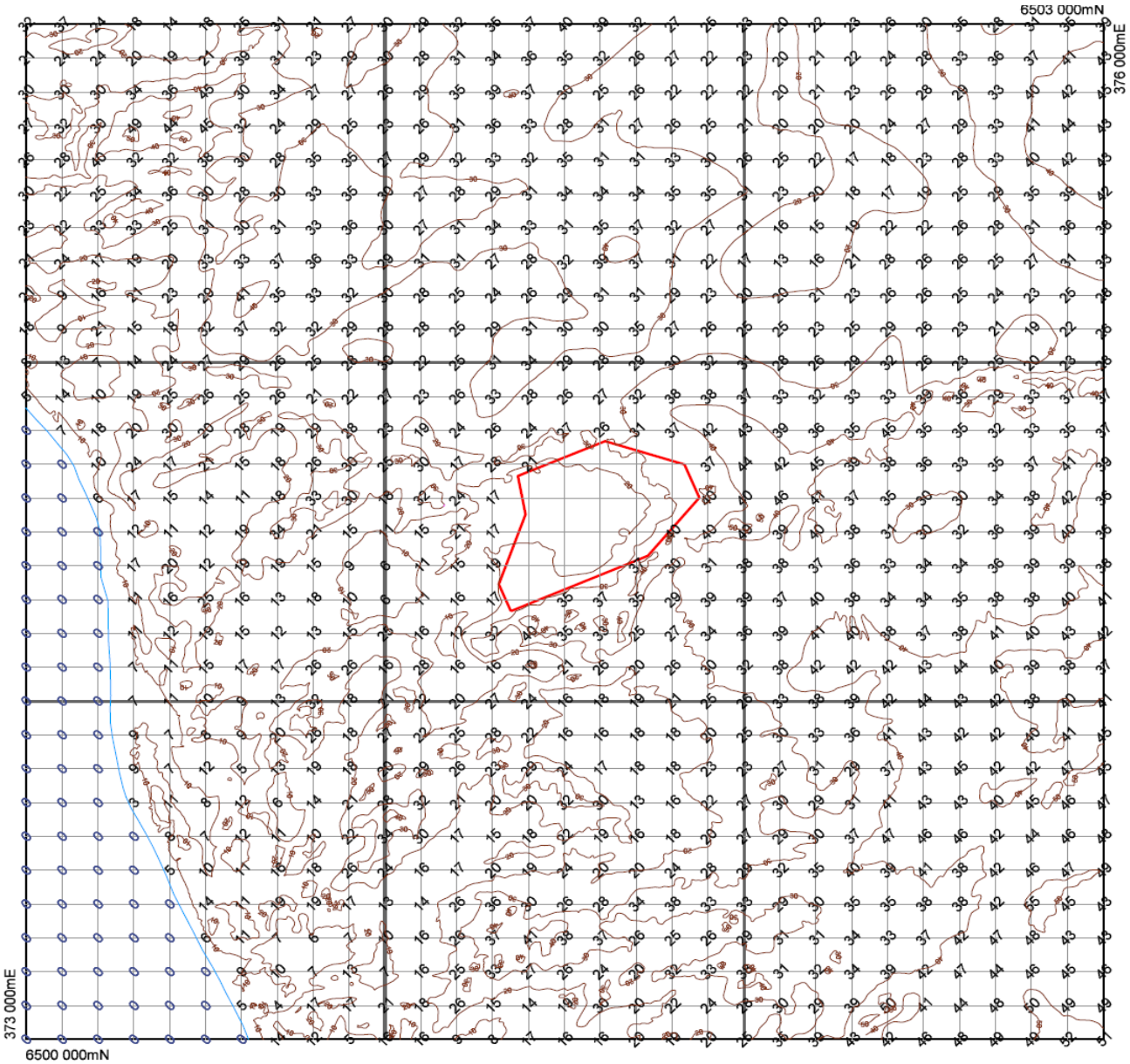
The Corporation will assess compliance with the odour criteria as follows:

1. Recording and actively investigating all odour complaints to determine the source and cause of the nuisance odour (which may or may not come from the Alkimos WWTP) - see Section 22 of the Odour Management Plan;
2. Conducting phone surveys of nearby residents every two years, as described in Section 21 of this plan;
3. Conducting an odour audit every two years of the Stage 1 operation to establish the effectiveness of the odour control system, the performance of odour treatment units, the level of odour coming from the oxidation ditches, the response of the public (as reported by odour complaints or community surveys) and any remedial actions required. The odour audit will include measurement of the distance from the plant that odour can first be detected, using the VDI technique.

13. Design – Size of the Stack

The base of the excavation is approximately 11 m above mean sea level. As shown in the topographical map in Figure 6, the land along the western side of the site is at an elevation of 17 to 19 m (6 to 8 m above the base of the excavation). However, land along the northern boundary has an elevation of 21 to 31 m, while the dunes to the east and south of the site reach an elevation of 40 m (about 29 m above the base of the stack).

Figure 6 Predicted Odour Contours- Stage 1 – Stack at 4,800 ou

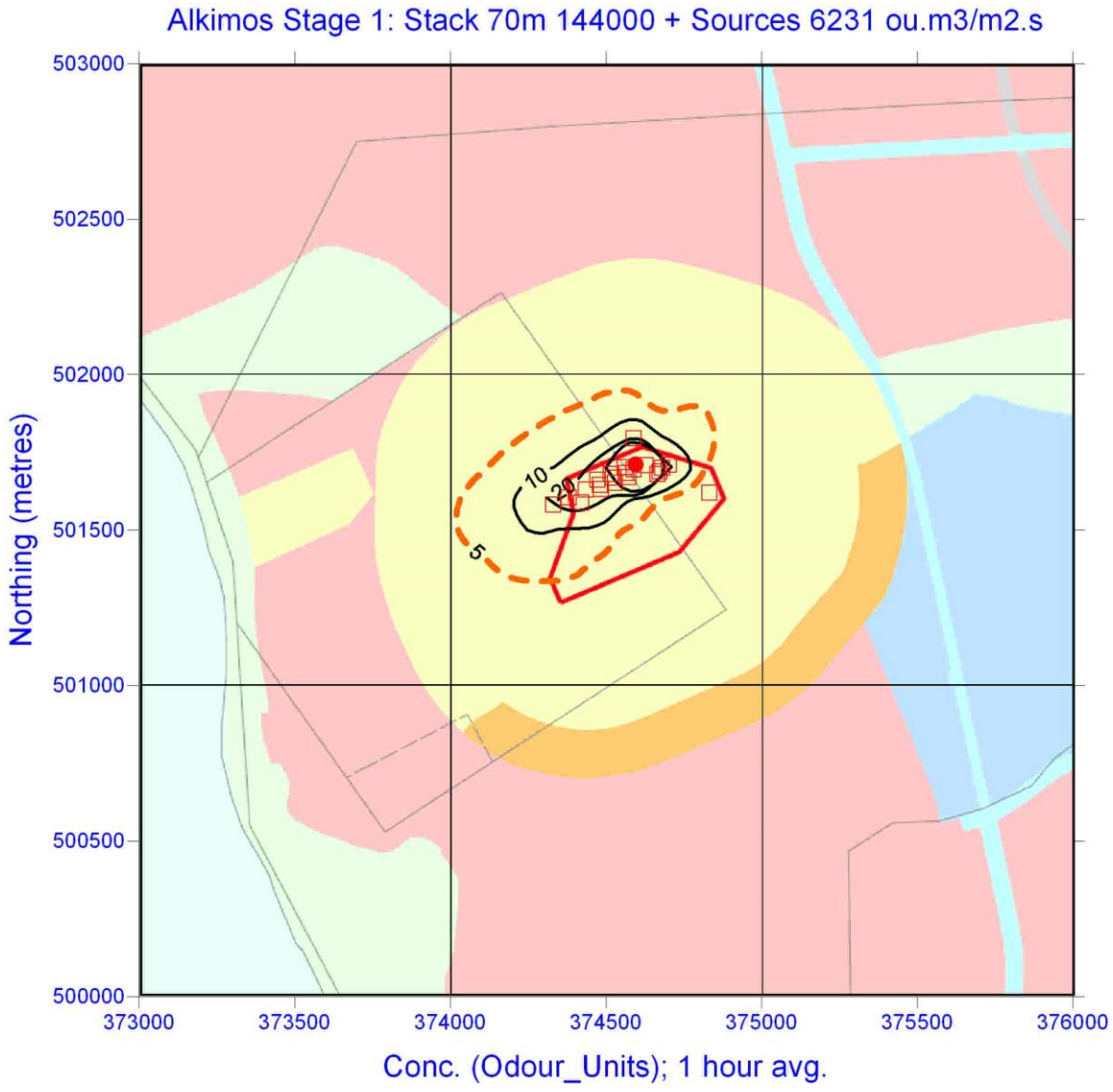


From the topography map in Figure 6, it can be seen that many of the high dunes are in the buffer zone. Nonetheless, there is land zoned residential that is at 30 to 40 m elevation, particularly to the southeast of the site. Based on the topography, the minimum feasible stack size is a height of 50 m (ie, elevation of top of stack is 61 m).

The implications of a higher stack were investigated. Figure 7 shows the predicted odour contours for the Stage 1 plant using a 70 m high stack. There is a reduction in the peak odour contour near the boundary of the buffer zone from 5 ou to 4 ou. Thus there is some benefit from the higher stack.

The Corporation has decided that it would be of more benefit to focus attention and expenditure on controlling fugitive emissions rather than construct a higher stack, as available odour treatment units can reduce odour concentrations to a level that can satisfactorily be dispersed through a 50 m high stack.

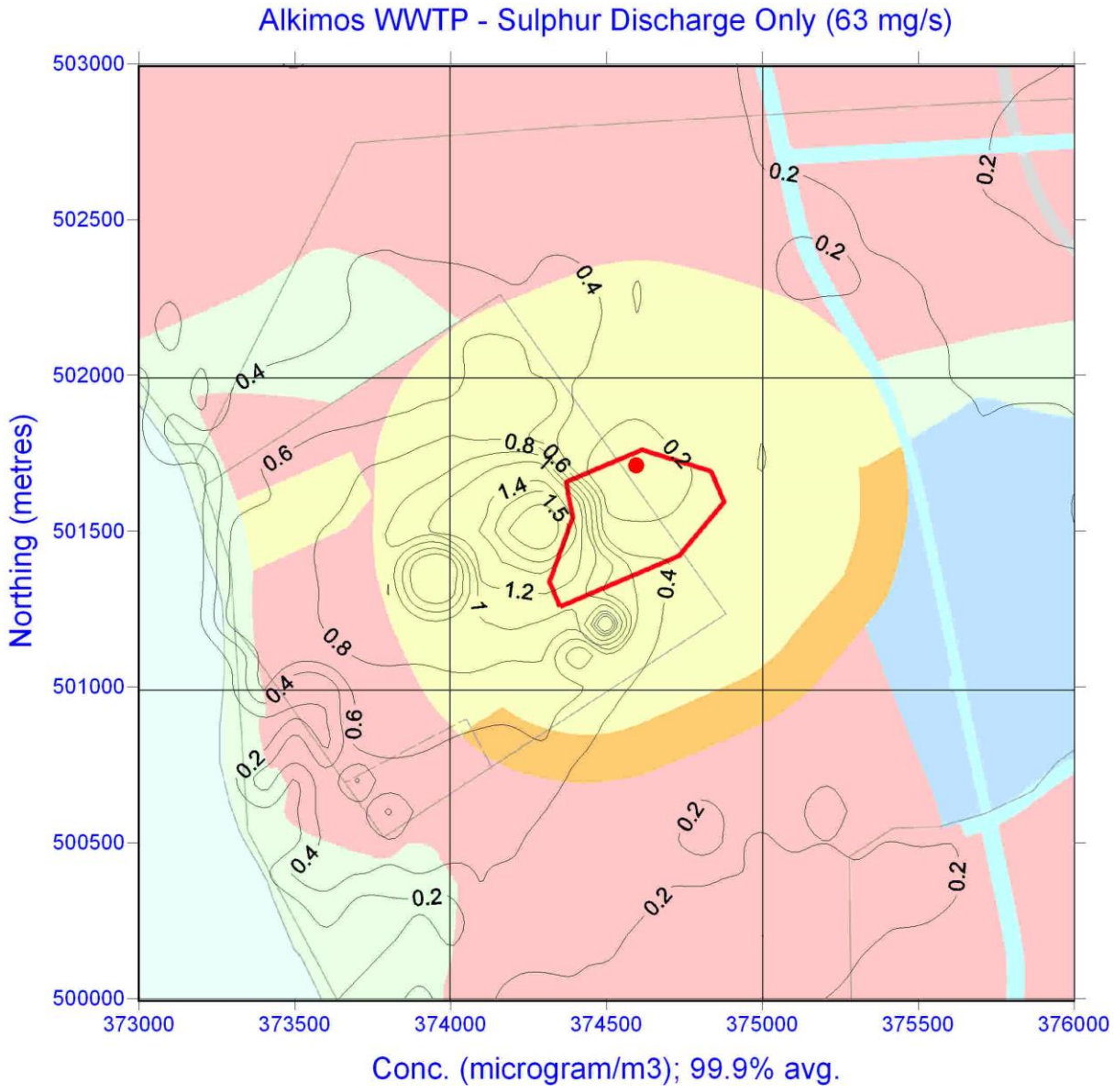
Figure 7 Predicted Odour Contours- Stage 1 – 70 m High Stack



14. Design – Sulphur Emission

The photo-ionisation unit is reported to convert approximately 60 per cent of the hydrogen sulphide entering the unit to elemental sulphur that is then discharged through the stack. Thus a model run was carried out to check the implications of the discharge of fine sulphur particles (as S_8). The manufacturer advised that the rate of discharge would be 63 mg/s. As shown in Figure 8, the predicted ground level concentration of sulphur is 1.5 ug/m^3, well within acceptable limits for fine particles (25 ug/m^3 for PM10). Sulphur is not considered to be a toxic element.

Figure 8 Predicted Ground Level Concentration of Sulphur



Appendix D sets out the reactions occurring in the photo-ionisation unit and the sulphur and odour balance in the unit.

15. Commissioning – Bioscrubber Acclimatisation

As noted above, bioscrubbers are not at present part of the Stage 1 or Stage 2 proposal, but may be installed if there is a need to reduce odour levels. (An alternative odour control technology may be installed if more appropriate).

If installed, sufficient bioscrubber units will be provided to allow the design air flow to be scrubbed with one bioscrubber as backup in each scrubber area. This allowance arrangement will allow full scrubbing capacity to be maintained during periods of major maintenance.

Any bioscrubbers installed will be acclimatised over a six week period. During this period, the bioscrubbers will be supplied with potable water and a nutrient mix. It was found at Woodman Point that, after six weeks, the bioscrubbers operated efficiently and could remove more than 95 per cent of incoming hydrogen sulphide.

16. Commissioning – Performance Testing

A key part of the commissioning is to check and verify the performance of the odour control systems. The proposed steps in commissioning are as follows:

1. Smoke tests under covers to confirm satisfactory degree of sealing.
2. Measurement of negative pressure and velocity at air intakes to confirm they meet design limits.
3. Measurement of duct velocities to check satisfactory flow balance and capture of air from covered tanks.
4. Validation of all measurement equipment.
5. Odour sampling with dynamic olfactometry tests will be undertaken on a weekly basis. At the commencement of the 14 day proving period the sampling period will be increase with a duplicate sample taken every second day. A simular sampling frequency would be adopted for the stack emission.
6. Measurement of odour levels in ducts by dynamic olfactometry.

17. Commissioning – Balancing Duct Flows and Pressures

As noted above, the velocities in the duct system must be measured during the commissioning stage to confirm that the design extraction rates from each process unit are being achieved.

Some minor increase in extraction rates may be used to achieve the design negative pressures in some areas. The major monitoring parameter for effective odour capture is the records of negative pressure in the various covered areas.

18. Commissioning and Ongoing Verification

Verification of performance involves six components:

1. Verification of odour capture, as described in Section 16;
2. Verification of odour treatment unit performance as described in Section 16 with regular sampling thereafter;
3. Reports from odour monitors on the boundary of the buffer zone during the commissioning stage, to confirm that odour is not detectible;
4. Conduct phone survey of up to 150 residents living within 1 km of buffer zone every 2 years during Stage 1 operations to ascertain whether odour is detectible and whether odour is a nuisance at times;
5. Odour audit every 2 years of operation, including deployment of odour monitors using VDI odour detection technique to measure extent of detectible odour plume; and
6. Odour modelling using the actual odour levels measured during the commissioning stage.

Note that odour "monitors' are local persons employed to report monthly on the incidence of noticeable odour in their neighbourhood. Odour monitors have been used successfully during the commission period of the Subiaco and Woodman Point odour management programs. The responsibility for verification testing and reporting is listed below.

Table 5. Verification Testing and Reporting - Alkimos WWTP

Verification Step	Responsibility
Smoke tests under covers	Installation contractor
Negative pressure- tests	Installation contractor
Negative pressure - monitoring	Operations
Scrubber performance test	Scrubber supplier
Measure fugitive emissions	Installation contractor
Measure odour in ducts	Odour audit
Odour audit and odour monitors	Odour audit
Update odour modelling	Odour audit
Report on verification	Odour audit

19. Operations – Standard Operating Procedures

Standard operating procedures are established to ensure that the odour control system continues to operate effectively during the service life of the system, under all normal and abnormal operating conditions. A list of likely standard operating procedures (or work instructions) is attached in appendix D.

Standard operating procedures set out the steps to be followed in operating and maintaining the plant, including the following aspects:

- Daily check of negative pressures under covers;
- Procedures for responding to odour treatment unit alarms;
- Procedures for maintaining odour treatment units;
- Procedures for cleaning and washing process tanks before covers are removed with minimal release of odour;
- Procedures for maintaining and removing mechanical equipment with minimal release of odour;
- Monthly reporting on performance of odour control system;
- Plan maintenance to avoid long shut-downs of equipment. Advise regulatory authority and local residents of major maintenance on the plant when the plant will be out of operation.

Standard operating procedures set out the detailed steps to keep the plant operating and in compliance through normal events, including taking units off-line for maintenance or testing, and also during emergency events. The plant is monitored by a computer-based system at all times and there are standard procedures for automatic and operator response to alarms that indicate potentially undesirable conditions at all times (24 hours per day).

The principal components of the odour control system are covers, ducts, fans and scrubbers. A key operations goal is to keep the fans operating all the time so that odour is extracted and scrubbed. Backup fans with automatics duty/standby units are provided, with automatic re-start after power failures, so that this goal is achieved for a very high proportion of the time.

Covers must occasionally be removed to maintain equipment in the tanks or for inspections. At such times, the flow is transferred from the tank to be inspected, the tank is emptied and flushed with recycled effluent, the extraction duct dampers are closed and then the covers are opened.

Inspections can be made using small covers which are opened only for short periods during day shift operations (when atmospheric mixing is greater then at night). The standard operating procedures require that covers cannot be open unless operations or maintenance personnel are at the site and the cover must be closed before they leave the cover.

Backup scrubber units with automatic standby are provided, as described elsewhere.

20. Operations – Replacement of Scrubber Media

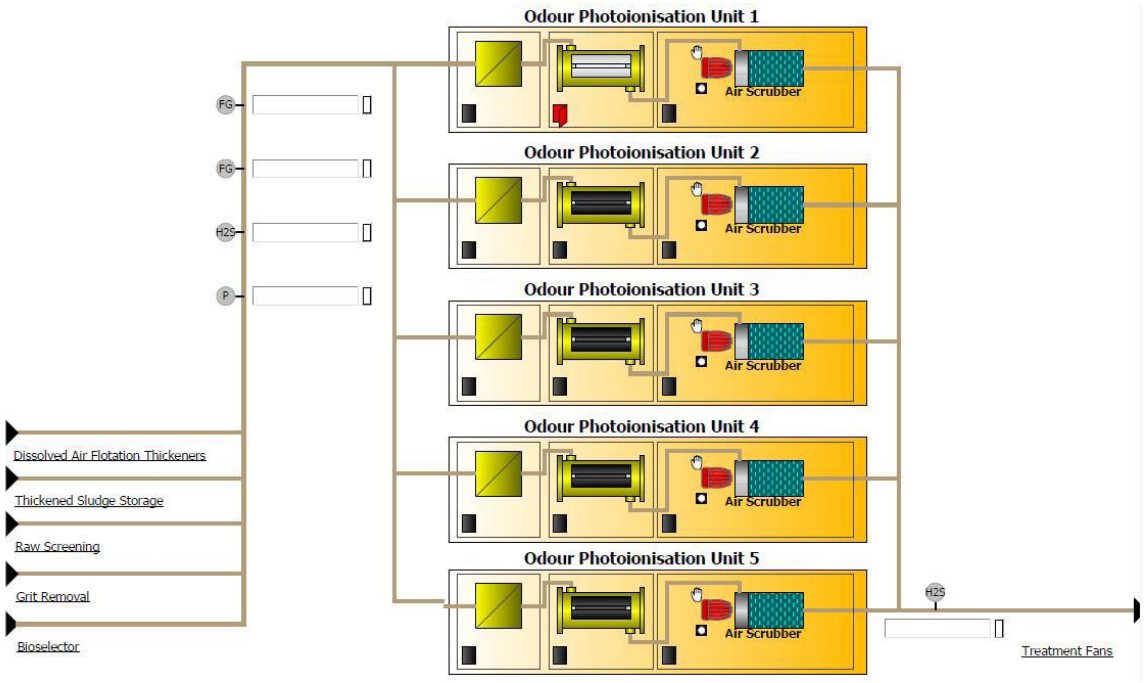
Activated carbon media is considered to have a service life of 5 years. Thus media replacement occurs more frequently but using the same procedure of replacing media one unit at a time, and keeping full treatment capacity in the other operating units.

The service life of UV lamps is expected to be about 2 years. Lamps may be removed and replaced quickly, so this should not be an operation that has an impact on the performance of the odour treatment system.

As indicated in the layout of the proposed photo-ionisation units for the Alkimos plant, multiple units are installed so that one unit can be maintained or repaired while the other units meet the full duty requirements for odour scrubbing.

If bioscrubbers are installed the media is considered to have a service life of 15 years. Thus when media needs to be replaced, it will be done one vessel at a time. During such periods, there will be marginally higher loads on the operating units, so media replacement should be programmed where feasible for winter when odour loads on the plant are lower.

Figure 9 Proposed Layout of Photo-ionisation Scrubbers at Alkimos WWTP



21. Monitoring – Regular Odour Monitoring

The following odour monitoring will be carried out:

- Continuous H2S monitoring at the entry to all odour treatment systems (and between different types of odour treatment units in the event that bioscrubbers are installed);
- Continuous H2S monitoring using in-situ monitoring equipment installed on the ducts at the discharge from all odour treatment systems;
- Continuous H2S monitoring at the entry to the stack;
- The H2S analysers will be calibrated in accordance with the manufacturers instructions.
- Collect odour samples at five points monthly for six months of operation after commissioning..

As noted above, a phone survey of up to 150 local residents living within 1 km of buffer zone will be carried out every 2 years during the Stage 1 operation of the plant (from 2011 to 2018) to seek further evidence as to whether or not there is a noticeable odour beyond the plant buffer zone.

The continuous monitoring will be carried out with hydrogen sulphide logging equipment as installed at the Subiaco, Beenyup and Woodman Point WWTPs. The manual testing will be carried out using Drager tubes to register hydrogen sulphide concentration.

22. Monitoring – Complaint Registration and Response

The Water Corporation will maintain a 24-hour phone line to allow any member of the public to report an odour complaint at any time. The following information is recorded for each complaint:

- Date and time of complaint;
- Concern expressed by person complaining;
- Address, time and duration of odour;
- Whether experienced at other times;
- Character of odour.

Within one working day, complaints are sent to the duty operator or treatment plant manager for investigation. The investigation considers the types of operations and maintenance at the plant at the time, wind speed and direction at the plant and other factors that may have caused or exacerbated the concern. A report on the complaint is stored.

The person making the complaint will be phoned (unless they ask not to be contacted) to advise that the complaint is being investigated and the findings to date.

As set out in the following section, if there are 3 or more odour complaints from two or more residents about odour from the Alkimos plant in a 3 month period, an investigation of odour problems will be initiated. The protocol to be followed is set out in the section below on the contingency plan.

23. Contingency Plans for Upsets or Maintenance

The Standard Operating Procedures will set out the steps to be followed in the event of upsets or major maintenance. The target will be to keep the odour treatment systems operating effectively for 99.9 % of the year (excluding external events such as power failures). This should be seen as a goal and not as a mandatory target.

Operating procedures will be designed to allow the full range of maintenance activities to occur without compromising the performance of the odour capture and scrubbing system. Typical standard operating procedures are set out in Appendix C.

As noted above, replacement of media is a relatively infrequent event. From experience with odour control systems at other plants, the major types of upsets are:

- Power supply failures;
- Failures of mechanical equipment, such as dosing pumps;
- Failures of the computer control system.

Experience at other plants with well-designed odour management systems shows that elevated odours beyond the buffer zone occur only if there is a prolonged power failure or other unusual event **and** there are weak winds with low mixing conditions.

All failures will automatically trigger alarms and operators are available on a 24-hour basis to take remedial action. The most common types of remedial actions are:

- Re-start following power or equipment failure;
- Initiate standby equipment;
- Bypass one unit and operate remaining odour treatment units at a slightly higher rate with remaining odour treatment units.

24. Contingency Plans in the Event of Exceedances

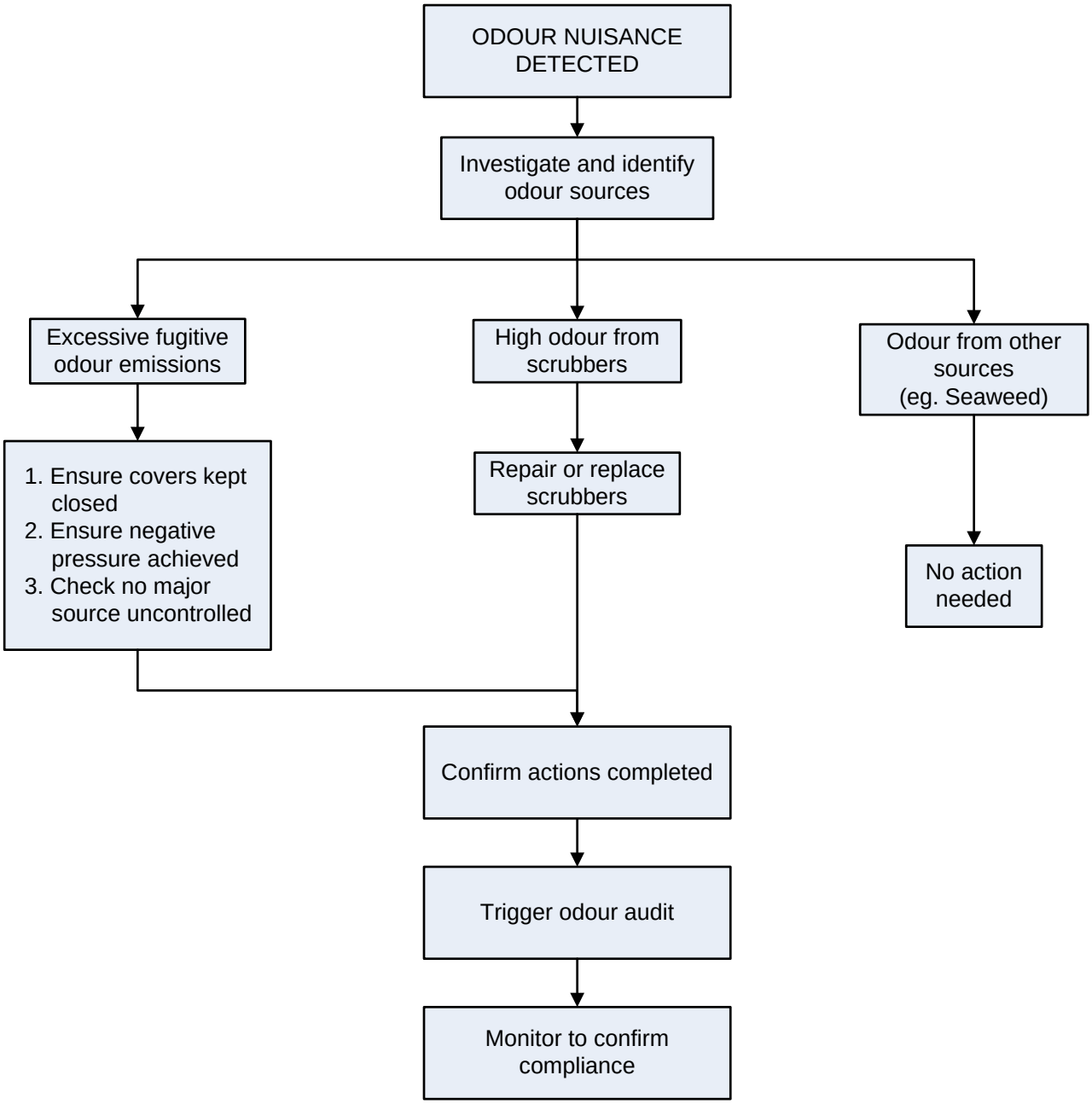
The Water Corporation will include in the operations procedures a contingency plan to investigate and resolve events and periods with high odour levels.

A period with high odour levels is taken to occur if there are 3 or more odour complaints from two or more residents about odour in a 3 month period, or the phone survey shows that the nearby community perceive odours coming from the Alkimos plant at an uncomfortable level. The protocol to follow in the contingency plan is set out below.

The plant has continuous monitoring of all units by a SCADA system and thus alarms are triggered in the event of failure of any item of equipment. Generally the contingency plan is to switch to standby or backup units – this normally occurs automatically as the action is taken by the computer control system.

Critical alarms are sent to the duty operator (there is always an operator on duty) so further manual action can be taken by the operator based on an assessment of the situation, the consequences and the available options. Recommended actions for all regular events are set out in standard operating procedures,

Protocol in event of exceedances


ODOUR NUISANCE DETECTED
Investigate and identify odour sources
Excessive fugitive odour emissions
High odour from scrubbers
Odour from other sources (eg. Seaweed)
1. Ensure covers kept closed
2. Ensure negative pressure achieved
3. Check no major source uncontrolled
Repair or replace scrubbers
No action needed
Confirm actions completed
Trigger odour audit
Monitor to confirm compliance

25. Reporting and Re-design as Required

An annual report will be prepared on the performance of the plant, including the odour control system.

There will be an odour audit every two years of the Stage 1 operation to establish the effectiveness of the odour control system, the performance of odour treatment units, the level of odour coming from the oxidation ditches, response of the public (as reported by odour complaints or community surveys) and any remedial actions required.

The annual report and odour audits will provide the information needed to select and optimise the design of future odour control technologies in later stages of the Alkimos WWTP and also to upgrade the Stage 1 works, if needed.

The Stage 1 plant is expected to handle flows for the period 2010 to 2018. Thus the provisions of the Odour Management Plan are expected to apply for this 8 year period. When the Stage 2 plant is designed, a new Odour Management Plan will be prepared.

It should be noted, however, that the findings of the odour audits every two years between 2011 to 2018 are expected to lead to some refinements and improvements in odour management, and there will be progressive improvements made to update the Odour Management Plan and standard operating procedures as a result of the audits.

26. Summary of Odour Management Plan

The procedures required to implement this Odour Management Plan are summarised below. This summary is for reference only; the preceding sections provide a fuller description and take precedence.

Table 6. Alkimos Odour Management Plan: Summary of Required Procedures

Aspect to be addressed	Required Procedure
Design	
A Preliminary treatment area	
A1	All tanks and channels to be fully covered with Appropriate corrosion-resistant covers specifically designed to capture odours
A2	Seals for covers to have flexible gaskets at least 30 mm wide
A3	Covers to be bolted at close spacing to achieve an air-tight seal
A4	All equipment and bins to be fully sealed with ducts to remove foul air
A5	Air extraction rates for tanks and equipment to meet Water Corporation best practice guidelines (12 to 45 air changes/hour)
A6	Negative pressure sensors in tanks and ducts, connected to SCADA system. Design negative pressure of – 15 Pa or better.
A7	Sufficient duct connection points on each tank to avoid dead zones.
A8	Measurement and monitoring points and equipment to be provided on ducts and before and after odour treatment unit. Standard measurement station just before stack.
B Secondary treatment area	
B9	All oxidation ditch tanks and channels to be fully covered with Appropriate corrosion-resistant covers specifically designed to capture odours
B10	Seals for covers to have flexible gaskets least 30 mm wide
B11	Covers to be bolted at close spacing to achieve an air-tight seal
B12	Velocity at air inlets to be 1.5 m/s or more
B13	Air extraction rate to be capable of 30,000 m^3/hr from each of the Stage 1 oxidation ditches
B14	Negative pressure sensors in tanks, connected to SCADA system. Design negative pressure of – 15 Pa or better.
B15	Sufficient duct connection points on each tank to avoid dead zones.
B16	Measurement and monitoring points and equipment installed on ducts
B17	No air path between ditches, so that any ditch can be taken out of service for maintenance without affecting odour capture
C Sludge area	
C18	All tanks to be fully covered with appropriate corrosion-resistant covers specifically designed to capture odours
C19	Seals for covers to have flexible gaskets least 30 mm wide
C20	Covers to be bolted at close spacing to achieve an air-tight seal

Aspect to be addressed	Required Procedure
C21	Negative pressure sensors in sludge storage and DAF tanks connected to the SCADA system. Design negative pressure of – 15 Pa or better.
C22	Air extraction rates for tanks and equipment in accordance with Water Corporation best practice guidelines.
C23	Sufficient duct connection points on each tank to avoid dead zones.
C24	Measurement and monitoring points and equipment installed on ducts
D Odour treatment units	
D25	All air extracted to be treated, with no bypassing
D26	Discharge odour from photo-ionisation unit to be less than 800 ou for 99 % of the time
D27	Redundancy to be provided, with a target availability for the odour treatment unit system of 99.9 % of the year
D28	Major maintenance to be carried out on non-operating unit with remaining units operating
D29	Continuous measurement of H2S before and after odour treatment units with SCADA logging of results
D30	Continuous measurement of air flow rate before the odour treatment units
D31	Measurement of odour before and after odour treatment units, and in oxidation ditch duct and stack discharge
D32	Measurement and monitoring points installed on ducts for manual sampling, and flow measurement and balancing
E Bioscrubbers	
E33	Install odour treatment (eg, bioscrubber) if odour concentration in air discharged from stack exceeds 4,800 ou
E34	Allow six week acclimatisation period for any bioscrubbers with supply of water and nutrients
Commissioning	
F Checking performance	
F35	Smoke tests under covers to confirm satisfactory degree of sealing
F36	Measurement of negative pressure and velocity at air intakes to confirm they meet design limits
F37	Measurement of duct velocities to check satisfactory flow balance and capture of air from covered tanks
F38	Validation of all measurement equipment
F39	Odour sampling with dynamic olfactometry tests will be undertaken on a weekly basis. At the commencement of the 14 day proving period the sampling period will be increase with a duplicate sample taken every second day. A simular sampling frequency would be adopted for the stack emission.
F40	Measurement of odour levels in ducts using dynamic olfactometry
F41	The H2S analysers will be calibrated in accordance with the manufacturers instructions.
F42	Repeat of odour modelling with actual odour levels

Aspect to be addressed	Required Procedure
G Verification of performance	
Refer to Table 5 for allocation of responsibilities for verification tasks	
G44	Verification of odour capture, as described in Section 16
G45	Verification of odour treatment unit performance as described in Section 16 with regular sampling thereafter
G46	Reports from odour monitors on the boundary of the buffer zone during the commissioning stage, to confirm that odour is not detectible
G47	Conduct phone survey of up to 150 residents living within 1 km of buffer zone every 2 years during Stage 1 operations to ascertain whether odour is detectible and whether odour is a nuisance at times
G48	Odour modelling using the actual odour levels measured during the commissioning stage
Operations	
H Operations and maintenance	
H49	Develop Standard Operating Procedures for operation and maintenance of covered tanks, duct and fan systems and odour treatment unit systems. Procedures to include: • Daily check of negative pressures under covers ; • Procedures for responding to odour treatment unit alarms; • Procedures for calibration of instrumentation in accordance with manufacturers recommendations; • Procedures for maintaining odour treatment units; • Procedures for cleaning and washing process tanks before covers are removed with minimal release of odour • Procedures for maintaining and removing mechanical equipment with minimal release of odour; • Monthly reporting on performance of odour control system. • Plan maintenance to avoid long shut-downs of equipment. • Advise regulatory authority and local residents of major maintenance on the plant when the plant will be out of operation.
H50	Replace bioscrubber when needed one vessel at a time. Media replacement should be programmed where feasible for winter when odour inputs to the plant are lower
H51	Replace activated carbon media when necessary. Replace media one unit at a time, keeping full treatment capacity in the other operating units
H52	Replace UV lamps as necessary ensuring this operation does not impact on the performance of the odour treatment system
Aspect to be addressed	**Required Procedure**
I Monitoring	
I53	Continuous H2S monitoring at the entry to all odour treatment systems (and between different types of odour treatment units in the event that bioscrubbers are installed)
I54	Continuous H2S monitoring at the discharge from all odour treatment

Aspect to be addressed	Required Procedure
	unit systems
I55	Continuous H2S monitoring at the entry to the stack
I56	The H2S analysers will be calibrated in accordance with the manufacturers instructions.
I57	Collect odour samples at five nominated sampling points monthly for six months of operation after commissioning and regularly thereafter.
I58	Conduct phone survey of up to 150 local residents every 2 years during the Stage 1 operation of the plant to seek further evidence as to whether or not there is noticeable odour beyond the plant buffer zone
I59	Maintain a 24-hour phone line to allow any member of the public to report an odour complaint at any time. Record the following information for each complaint: • Date and time of complaint • Concern expressed by person complaining • Address, time and duration of odour • Whether odour noticed at other times • Character of odour
I60	Within 1 working day, send complaints to the duty operator or treatment plant manager for investigation. Contact the person making the complaint (unless they ask not to be contacted) to advise that the complaint is being investigated and the findings to date.
Contingency Plan	
J Contingency plan	
J61	Establish Standard Operating Procedures to be followed in the event of upsets or major maintenance. The target will be to keep the odour treatment systems operating effectively for 99.9 % of the year
J62	Provide alarms to identify failures of equipment and systems. Ensure operators monitor alarms and personnel are available on a 24-hour basis to take remedial action
J63	Include in the operations procedures a contingency plan to investigate and resolve events and periods with high odour levels
J64	Establish a protocol to follow to resolve high odour levels as part of the contingency plan (see Section 24).
J65	Prepare an annual report on the performance of the plant, including the odour control system
J66	Conduct an odour audit every two years of the Stage 1 operation to establish the effectiveness of the odour control system, the performance of odour treatment units, the level of odour coming from the oxidation ditches, the response of the public (as reported by odour complaints or community surveys) and any remedial actions required

Alkimos Odour Management Plan – Appendices

Appendix A. CEE, "*Report on Buffer Zone for Proposed Future Alkimos WWTP Incorporating CSIRO Reports on Alkimos Ponding"*, Report to Water Corporation, 2006

Appendix B. Alkimos Water Alliance, *"Operations and Maintenance Manuals for Alkimos WWTP"*, 2010

Appendix C. Water Corporation, *"Schedule of Standard Operating Procedures for Odour Control Facilities"*, 2010

Appendix D. Alkimos Water Alliance, *"Odour Flux Balance for Alkimos WWTP"*, Report to Water Corporation, 2010

Appendix E. Alkimos Water Alliance, *"Functional Control Description for Alkimos WWTP Stage 1"*, Report to Water Corporation, March 2010

Appendix F. EML, *"Results of Odour Monitoring at Woodman Point WWTP"*, 2010

Alkimos Odour Management Plan – 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).

CEE "*Odour Management Plan for Alkimos Wastewater Treatment Plant",* September 2010