REPORT

ODOUR ASSESSMENT – SEWAGE TREATMENT PLANT MURWILLUMBAH

Newland Developments

Job No: 5311

5 May 2011

A PEL Company

PROJECT TITLE:	**ODOUR ASSESSMENT – SEWAGE TREATMENT PLANT MURWILLUMBAH**
JOB NUMBER:	**5311**
PREPARED FOR:	Dale Scotcher
	NEWLAND DEVELOPMENTS
PREPARED BY:	Geordie Galvin
QA PROCEDURES CHECKED BY:	Peter D'Abreton
APPROVED FOR RELEASE BY:	Chaim Kolominskas
DISCLAIMER & COPYRIGHT:	This report is subject to the copyright statement located at www.paeholmes.com © Queensland Environment Pty Ltd trading as PAEHolmes ABN 86 127 101 642

DOCUMENT CONTROL

VERSION	DATE	PREPARED BY	REVIEWED BY
01	05.05.2011	Geordie Galvin	Chaim Kolominskas
02	20.09.2011	Geordie Galvin	Micheal Fogarty

Queensland Environment Pty Ltd trading as
PAEHolmes ABN 86 127 101 642

BRISBANE:
Level 1, La Melba, 59 Melbourne Street, South Brisbane QLD 4101
PO Box 3306, South Brisbane QLD 4101
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

ADELAIDE:
72 North Terrace, Littlehampton SA 5250
PO Box 1230, Littlehampton SA 5250
Ph: +61 8 8391 4032
Fax: +61 7 3844 5858

PERTH:
Level 18, Central Park Building,
152-158 St Georges Terrace, Perth WA 6000
Ph: +61 8 9288 4522
Fax: +61 8 9288 4400

SYDNEY:
Suite 203, Level 2, Building D, 240 Beecroft Road
Epping NSW 2121
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

MELBOURNE:
Suite 62, 63 Turner Street, Port Melbourne VIC 3207
PO Box 23293, Docklands VIC 8012
Ph: +61 3 9681 8551
Fax: +61 3 9681 3408

GLADSTONE:
Suite 2, 36 Herbert Street, Gladstone QLD 4680
Ph: +61 7 4972 7313
Fax: +61 7 3844 5858

Email: info@paeholmes.com
Website: www.paeholmes.com

DISCLAIMER

PAEHolmes acts in all professional matters as a faithful advisor to the Client and exercises all reasonable skill and care in the provision of its professional services.

Reports are commissioned by and prepared for the exclusive use of the Client. They are subject to and issued in accordance with the agreement between the Client and PAEHolmes. PAEHolmes is not responsible for any liability and accepts no responsibility whatsoever arising from the misapplication or misinterpretation by third parties of the contents of its reports.

Except where expressly stated, PAEHolmes does not attempt to verify the accuracy, validity or comprehensiveness of any information supplied to PAEHolmes for its reports.

Reports cannot be copied or reproduced in whole or part for any purpose without the prior written agreement of PAEHolmes.

Where site inspections, testing or fieldwork have taken place, the report is based on the information made available by the client or their nominees during the visit, visual observations and any subsequent discussions with regulatory authorities. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to PAEHolmes is both complete and accurate. It is further assumed that normal activities were being undertaken at the site on the day of the site visit(s), unless explicitly stated otherwise.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

PAEHolmes was engaged by Newland Developers to perform an odour assessment relating to a subdivision at Murwillumbah, New South Wales.

1.1 Background

The Riva View Estate is located off Barnby Street at Murwillumbah in Northern New South Wales. The Estate has been defined by three stages, Stage 1 (Lots 101-133), Stage 2 (Lots 201-236) and Stage 3 (lots 301-332). Of relevance to the estate is the nearby Murwillumbah Sewerage Treatment Plant (STP) which is to the North of the development.

The meeting task sheet published by Tweed Shire Council (TSC) on 15 December 2004 considered the site and the relevance of the buffer between the development and the STP. Whilst the TSC did not accept the plan put to council, they did state:

> *Council has undertaken augmentation work on the STP which resulted in the odour sources from the inlet works and extended aeration treatment units being covered and relocating the treatment units further to the north. These works were deemed to be satisfactory by the Public Works for the existing residents. As such it is considered the buffer of 230 metres to the nearest residential allotment as provided in the Master Plan is satisfactory.*

Subsequently we understand that the development was approved in stages. On 25 August 2010, NSW Planning indicated to Tweed Shire Council that they would require: *an assessment of the potential for air or airborne (odour) pollution from the adjacent sewage treatment works* relating to the finalisation of the development.

1.2 Objectives of Study

The objective of the study was to determine the level of odour impact on the Riva Vue development from the nearby Sewage Treatment Plant (STP).

1.3 Scope of Work

The scope of work for the project included the following elements:

- Perform a site visit.
- Collect input data for the models.
- Perform odour sampling.
- Estimate odour emissions for the STP.
- Perform meteorological and dispersion modelling for both sites.
- Process model output data.
- Analyse modelling results and compare to relevant criteria.
- Report results and recommendations.

2 THE SITE

The Riva Vue estate is located at Murwillumbah in New South Wales. Part of the proposed development area has previously been approved, with the exception of one area which is being assessed as to finalise the development. The development area is shown below in Figure 2-1 and the future development area can be clearly seen with in the red line. The yellow, pink and orange shaded areas indicate various stages of the development.

Figure 2-1: Overview of Development. Future Development is within the Red Line

Critical to the approval of the future development area, is the potential impact from the nearby STP on the site. A site visit was performed on 2 March 2011 and the STP site was found to be operating well, with minimal odours detected. Critically, the STP currently uses a biofilter to treat odours from the inlet works, and has a shade cloth cover over the aeration basins. The benfit of the use of shade cloth is that the material acts to limit the wind speeds above the basin, which in turns reduces the potential for odours to be stripped from the surface of the liquid in the basins.

It is these two sources which are likely to generate the most emissions. Considering current management practices (i.e. biofiltration and the use of shade cloth), the risk of odour impact on nearby residences is considered relatively low.

The STP was found to have the following potential odour sources:

- Aeration tanks.
- Effluent storage lagoon.
- Sludge lagoon.
- Sludge drying beds (inside the old trickling filter area).

The location of these sources is shown in Figure 2-2 below.

Figure 2-2: Odour Sources

3 METHODOLOGY

3.1 Dispersion Modelling Methodology

The air dispersion modelling conducted for this assessment has been based on an advanced modelling system using the models TAPM and CALMET/CALPUFF (see Figure 3-1). This system substantially overcomes the basic limitations of the steady-state Gaussian plume models such as AUSPLUME. These limitations are most severe in very light winds, in coastal environments, and where terrain affects atmospheric flow. CALMET/CALPUFF is often used for odour-related assessments as it can effectively represent the effect of impacts under low wind speed conditions.

The modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as modelled upper air data generated for example by TAPM.
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.

3.1.1 TAPM

The Air Pollution Model, or TAPM (version 4), is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided elsewhere. The Technical Paper by Hurley (2005) describes technical details of the model equations, parameterisations, and numerical methods. A summary of some verification studies using TAPM is also given in Hurley *et al*. (2005).

TAPM v4 solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and (optionally) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses.

A major change to TAPM v4 from TAPM v3 is the improvement of predictions of low wind speed conditions. These changes have been shown to improve the frequency of predicted low wind conditions for a number of datasets.

Upper air data were generated over the study region using TAPM. The TAPM-generated data and observed surface meteorological data were then used in the CALMET diagnostic meteorological model, which is discussed below.

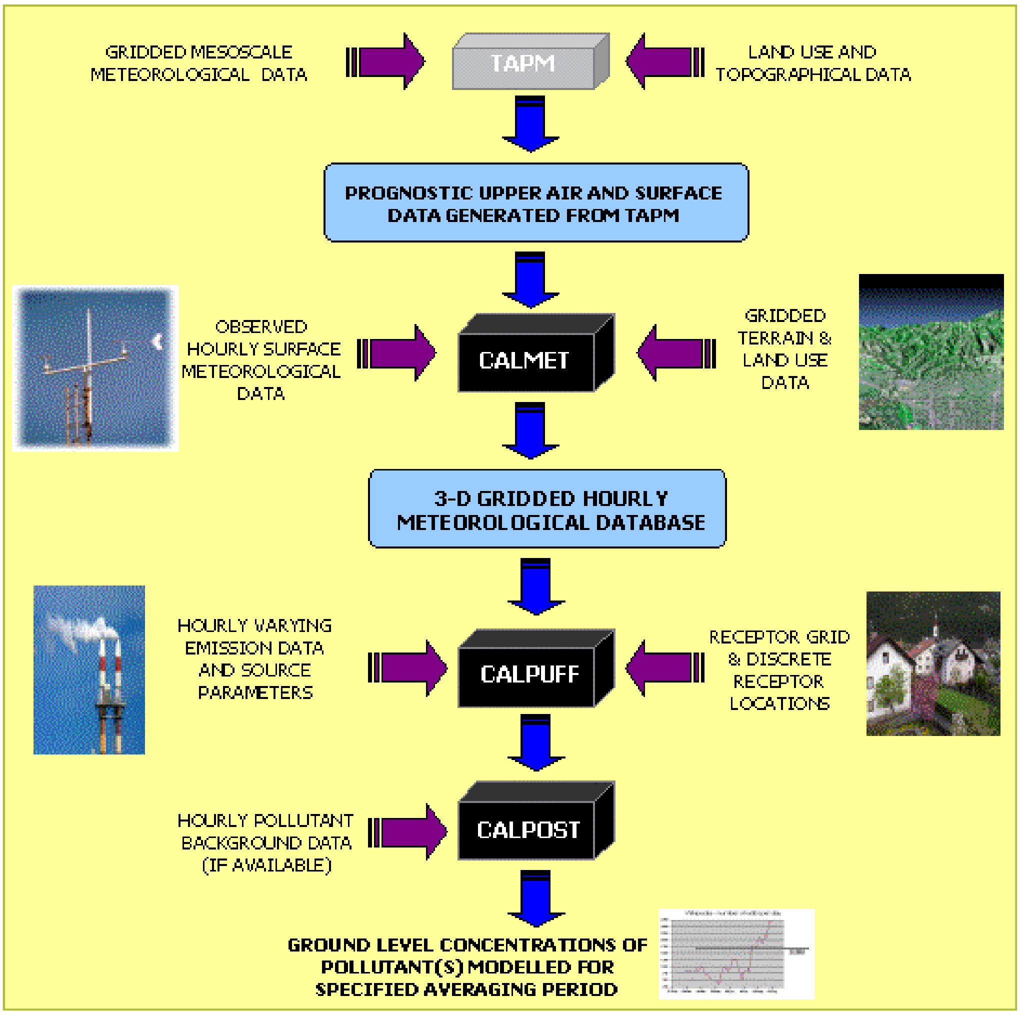


Figure 3-1: Modelling Methodology Used in this Study

3.1.2 CALMET

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are used in the CALPUFF dispersion model.

The hourly TAPM-generated data and observed data for the period of analysis were used as input to the CALMET pre-processor to create a fine resolution, three-dimensional meteorological field for input into the dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict girded meteorological fields for the region.

Terrain data has been sourced from the Shuttle Radar Topography Mission dataset and land-use data was sourced from standard sources. The spatial resolution of this data is 100 m.

Due to a lack of local observed data, observed data from the Coolangatta, Casino and Lismore stations were used. The data were supplemented with upper air data derived from TAPM simulations.

3.1.3 CALPUFF

CALPUFF (Scire *et al.,* 2000a) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

As with any air dispersion model, CALPUFF requires inputs in three major areas:

- Emission rates and source details.
- Meteorology.
- Terrain and surface details, as well as specification of specific receptor locations.

CALPUFF is endorsed by the US EPA, and has been used in numerous studies in Queensland.

3.1.4 Source Details

As all sources were area sources, they were represented in the model as area sources.

3.2 Emissions Estimation

STPs include a number of unit processes for treating wastewater, with varying odour-generating characteristics. Some potentially relevant odour sources were identified during the site visit to the plant and are addressed in this section.

In reality, odour emissions are highly variable and are a function of many factors, including type of source, wastewater composition, influent flow rate, ambient conditions (e.g. temperature, wind speed, atmospheric stability) and coverage of the source. Because many of the sources of variation are not quantified or even identified adequately at this stage, emissions estimation must be considered approximate only.

During the site visit, the major odour sources were identified. These are summarised in Table 3-1.

Table 3-1: Summary of Major Odour Sources

Odour Source	Source Type
Inlet Works	Treated (no emissions).
Aeration Process	Area
Effluent Storage Lagoon	Area
Sludge Lagoon	Area
Sludge Stockpile/Drying	Area

To complement data already held by PAEHolmes, site-specific odour emissions data were collected by newEQ on behalf of PAEHolmes at the three most critical sources. The results of the testing are summarised below in Table 3-2. Samples were collected in accordance with AS4323.3 and AS4323.4 (flux chamber (IFC)).

Table 3-2: Results of Odour Sampling

Source	Sample 1 ($ou/m^2/sec$)	Sample 2 ($ou/m^2/sec$)	Average ($ou/m^2/sec$)
Sludge Lagoon	0.262	0.262	0.262
Aeration Basin	0.213	0.094	0.154
Effluent Lagoon	0.063	0.051	0.057

Corrections for wind speed and atmospheric stability have been applied to odour emission rates that have been based on measurements with isolation flux chambers (IFC). Conditions simulated inside isolation flux chamber are very calm and stable, with a very light crosswind. These simulated conditions compare best with Pasquill-Gifford stability class F[a] and very low wind speed in the open atmosphere. However, in reality, odour emissions from many exposed areas vary with the atmospheric stability class and wind speed, and a constant odour emission rate is not strictly correct. Therefore, odour emission rates for a number of sources have been varied with wind speed and stability class by applying the scaling factors shown in Table 3-3[b].

The assumption of 0.5 m/s at class F (10 metres) equates to an emission rate of around 30% of the reference point (100% shown in Table 3-3). The emissions were varied from the reference point according to Table 3-3 prior to being input into the model.

Table 3-3: Assumed Variation of Emissions (Watts, 2000)

Wind Speed Category	Wind Speed Range (m/s)	Median Wind Speed (m/s)	Relative Odour Emission Rate Stability Class					
			A	B	C	D	E	F
1	0-0.6	0.3	86%	86%	80%	72%	46%	30%
2	0.6-1.2	0.6	149%	149%	139%	125%	80%	52%
3	1.2-1.8	0.9	192%	192%	180%	161%	104%	67%
4	1.8-2.4	1.2	227%	227%	213%	190%	123%	79%
5	2.4-3.0	1.5	257%	257%	241%	216%	139%	90%
6	>3.0	1.8	399%	399%	374%	335%	216%	139%

Note: Ambient wind speed measured at 10 m

The adopted odour emissions rates are shown in Table 3-4 for the site. We have not included variations due to inflow (i.e. emissions are maximised at times of maximum inflow) but instead adopted a conservative approach where the emissions are maximised throughout the day.

[a] Pasquill-Gifford stability classes reflect the turbulence in the lower layers of the atmosphere. They range from A (very unstable) to F (very stable) and determine the calculated rate of spread of a plume. They also relate to the level of turbulence in the flow.

[b] Emission rates equal to those sampled by the flux hood have been used directly in the model only when the wind speed is less than 0.3 m/s and the Pasquill-Gifford stability class is F. For the remainder of wind speed and stability class combinations, the emission rates will be greater than those sampled using the flux hood. Because dispersion of the odour will also be more effective, maximum ground level odour concentrations in proximity to the site will be approximately similar to those predicted using a less precise method involving constant emission rates.

Table 3-4: Adopted Odour Emission Rates (adjusted)

Source	Adopted Base OER (ou/m^2/s)	Comment
Inlet Works	Nil	Treated
Aeration Processes	0.51	Average of Site Specific Data
Sludge Lagoon	0.87	Average of Site Specific Data
Treated Effluent Storage Lagoon	0.19	Average of Site Specific Data
Sludge Storage/Drying Areas	0.67	Sydney Water Database, based on typical emissions for similar sources

4 METEOROLOGICAL DATA USED IN ASSESSMENT

4.1 Wind

Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – N, NNE, NE, etc. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualize how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The model-generated site-specific wind roses for 2008 are shown Figure 4-1. These are characterised by wind from most directions but with a westerly component in the mornings, with a relatively high frequency of low wind speeds. During the morning, the wind speeds increase, with a more noticeable south easterly component. During the afternoon, and through the evening, there is a noticeable increase in winds from the east due in large part to the seabreeze effect. Figure 4-2 summarises the wind statistics for all hours over the year.

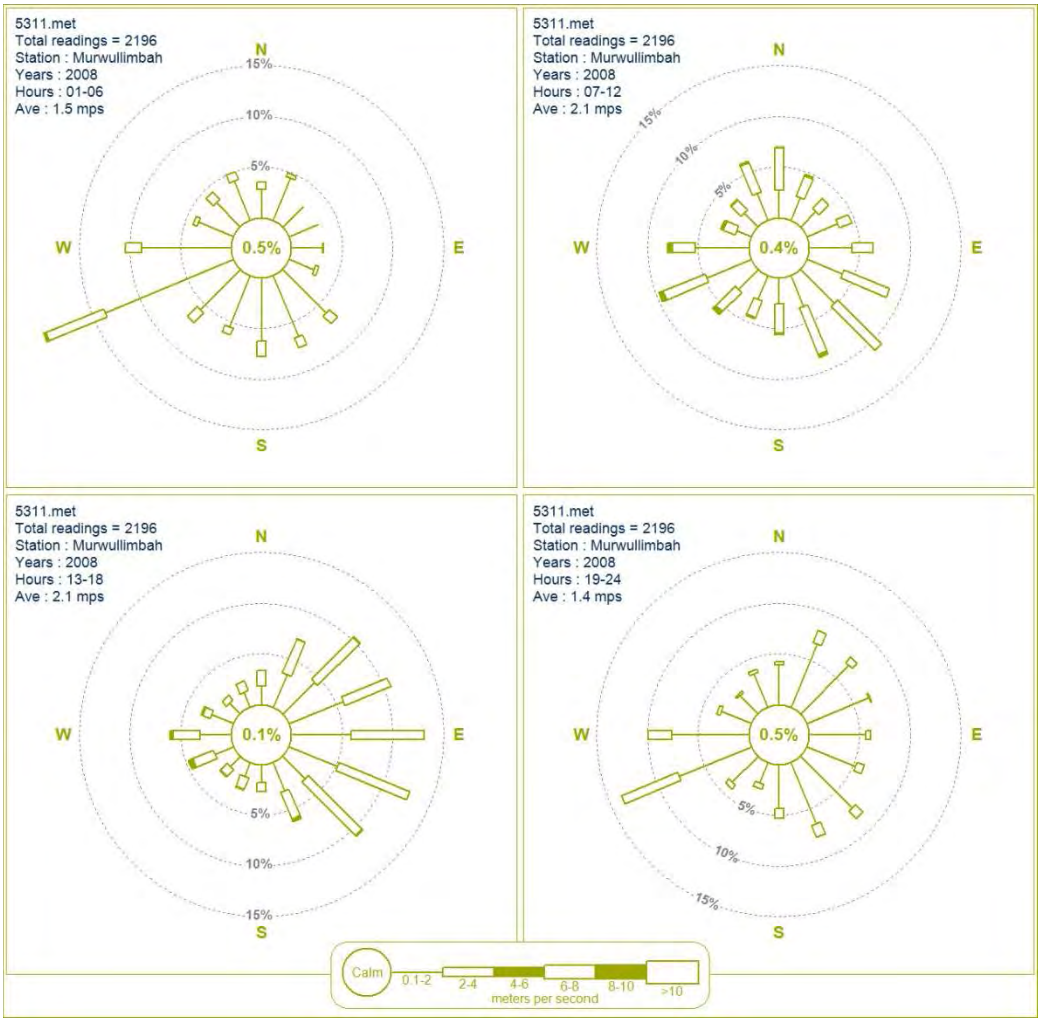


Figure 4-1: Wind Roses for January to December 2007

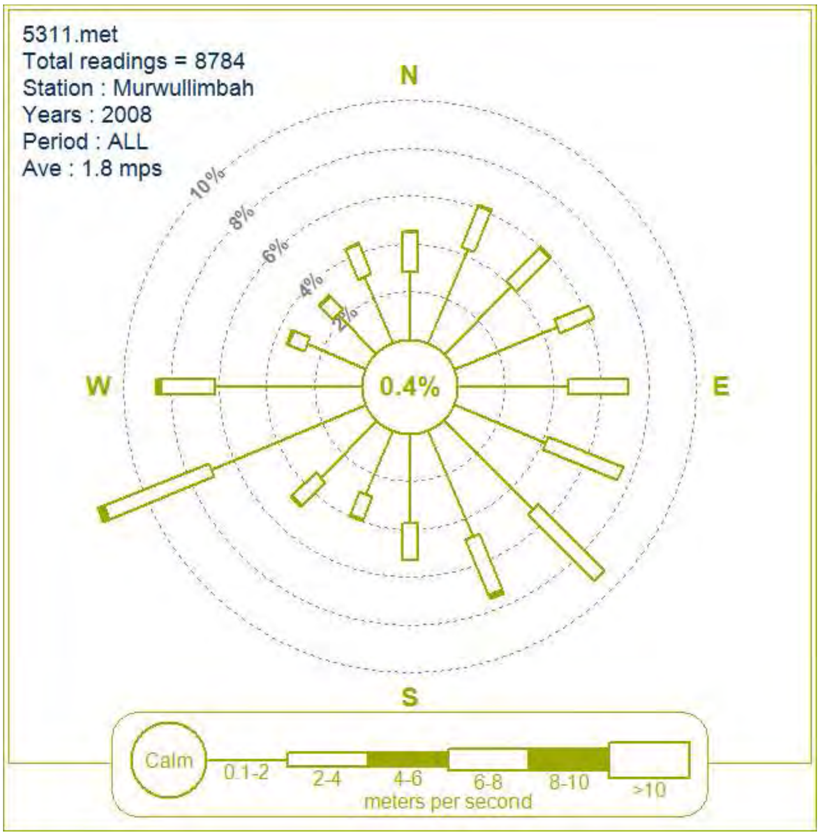


Figure 4-2: Wind Roses for All Hours January to December 2007

The frequency distribution of hourly averaged wind speed values is shown in Figure 4-3. Light wind speeds occur very frequently (up to 2 m/s), and occur approximately 39% of the time. Strong winds (greater than 6 m/s) do not occur.

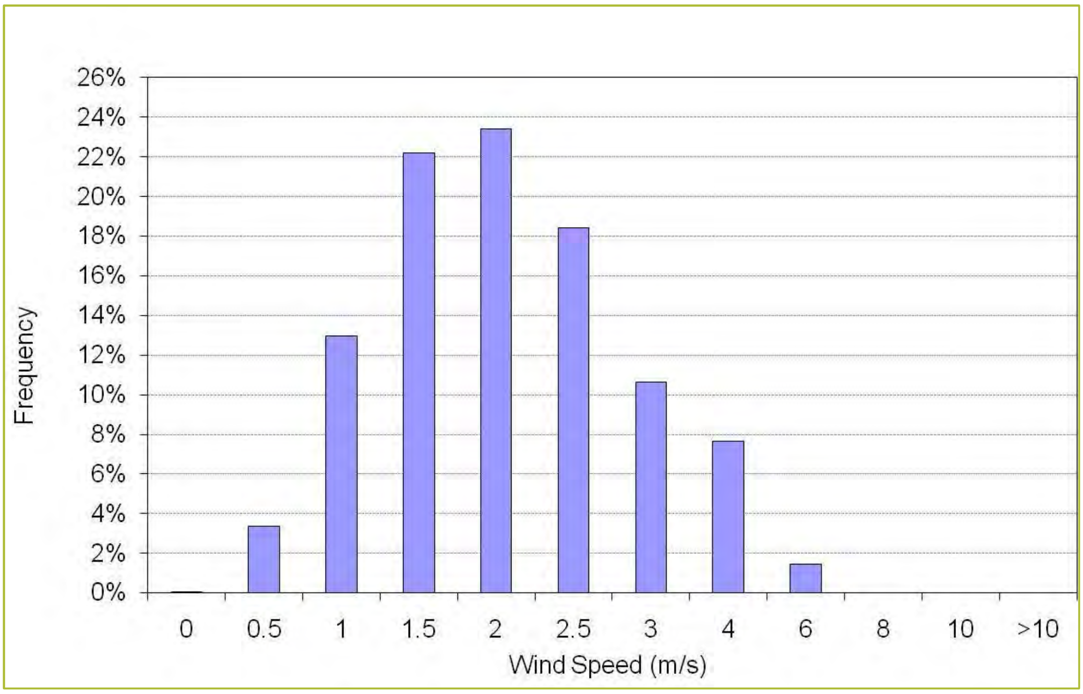


Figure 4-3: Wind Speed Distribution for 2008

4.2 Stability

Atmospheric turbulence is an important factor in plume dispersion. Turbulence acts to increase the cross-sectional area of the plume due to random motions, thus diluting or diffusing a plume. As turbulence increases, the rate of plume dilution or diffusion increases. Weak turbulence limits plume diffusion and is a critical factor in causing high plume concentrations downwind of a source, particularly when combined with very low wind speeds.

Turbulence is related to the vertical temperature gradient, the condition of which determines what is known as stability, or thermal stability. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe atmospheric conditions and thus dispersion.

The most well-known stability classification is the Pasquill-Gifford scheme[c], which denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution.

At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind.

Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is

[c] A more accurate turbulence scheme within CALPUFF, based on micrometeorological parameters, was used for modelling.

linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

The frequency distribution of estimated stability classes in the meteorological file is presented in Figure 4-4. The data show a total of 49% of hours with either E or F stability class which is relatively high but typical of inland locations with frequent light winds.

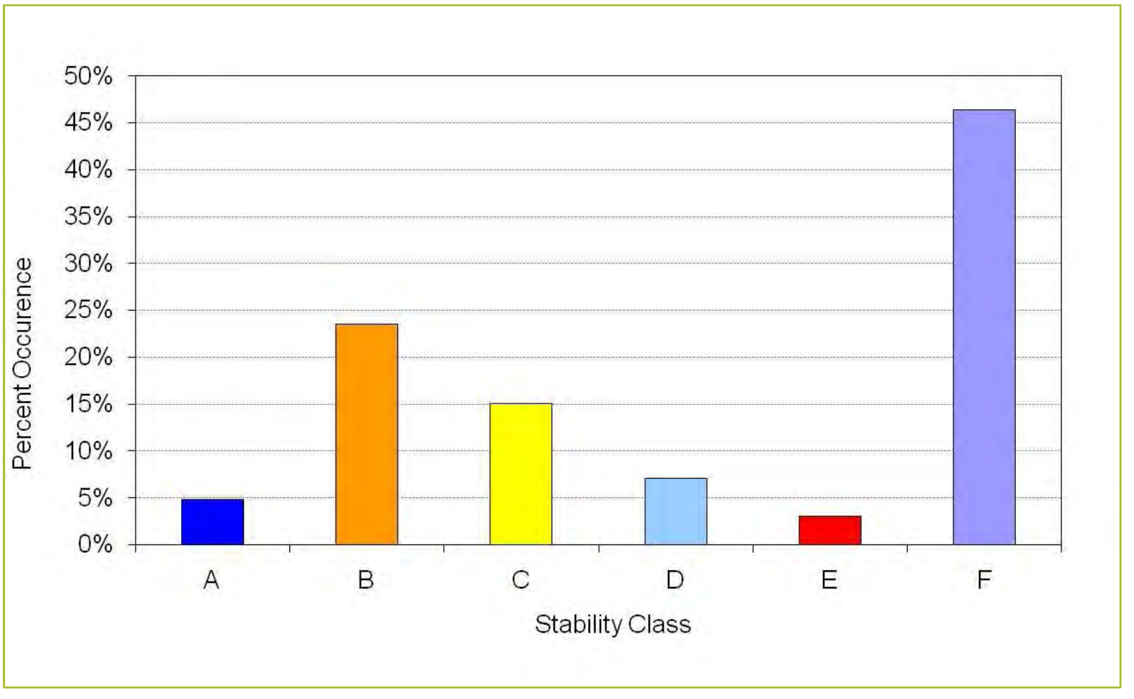


Figure 4-4: Frequency Distribution of Estimated Stability Classes

4.3 Mixing Height

Mixing height is the depth of the atmospheric surface layer beneath an elevated temperature inversion. It is an important parameter in air pollution meteorology as vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height. This is because the air above this layer tends to be stable, with restricted or vertical motions.

A series of internal algorithms within CALMET are used to calculate mixing heights for the subject site.

The diurnal variation of mixing height is summarised in Figure 4-4. The diurnal cycle is clear in this figure. At night, mixing height is normally relatively low. After sunrise, it typically increases to between 500 m and 3,000 m in response to convective mixing that result from solar heating of the earth's surface. The mixing height in the model was limited to 3,000 m. This has no effect on predicted odour impacts due to the low level nature of the plume.

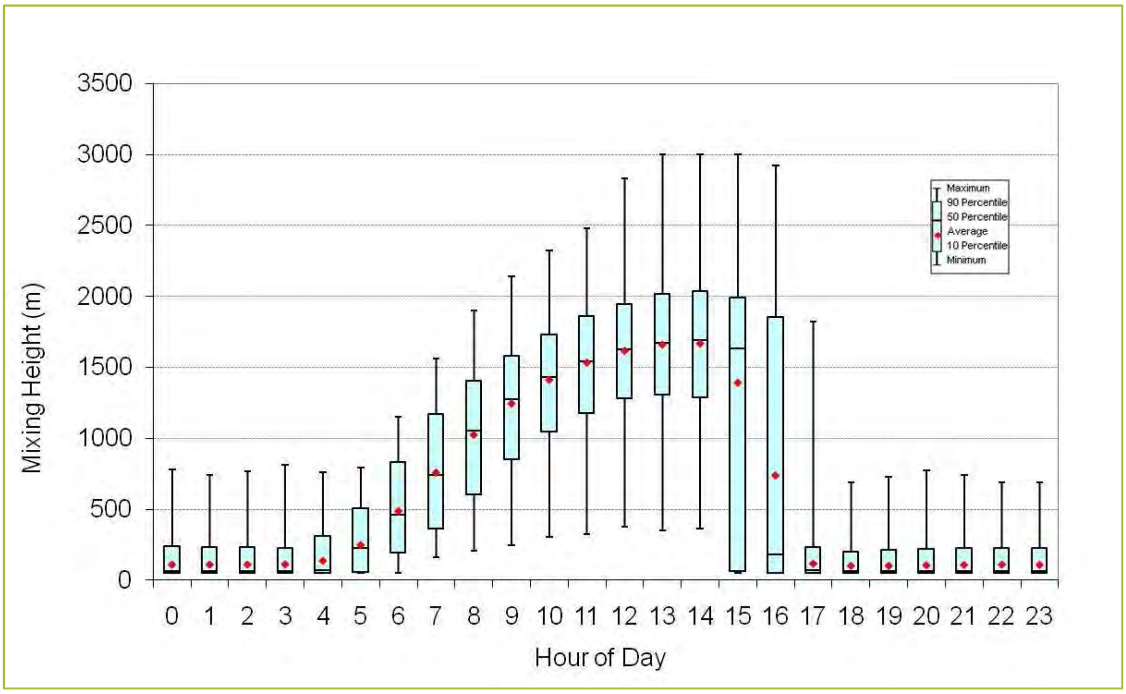


Figure 4-5: Estimated Mixing Height for Site

5 ODOUR CRITERIA

5.1 Background

The NSW "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"* (NSW Office of Environment and Heritage, 2005) proposes odour performance criteria of $C_{99\ 1\ sec}$ = 2 to 7 ou. The target odour concentration depends on the affected population, and is averaged over the nose response time, which is taken to be approximately 1 second. In this case, the 99^{th} percentile odour concentration at each receptor is applied.

The application of the NSW odour criteria involves taking into account the population affected by specified odour levels as per Table 5-1.

Table 5-1: NSW Odour Criteria

Population of Affected Community	Odour Criteira (ou)
Urban area (>2000)	2
500-2000	3
125-500	4
30-125	5
10-30	6
Single residence (<2)	7

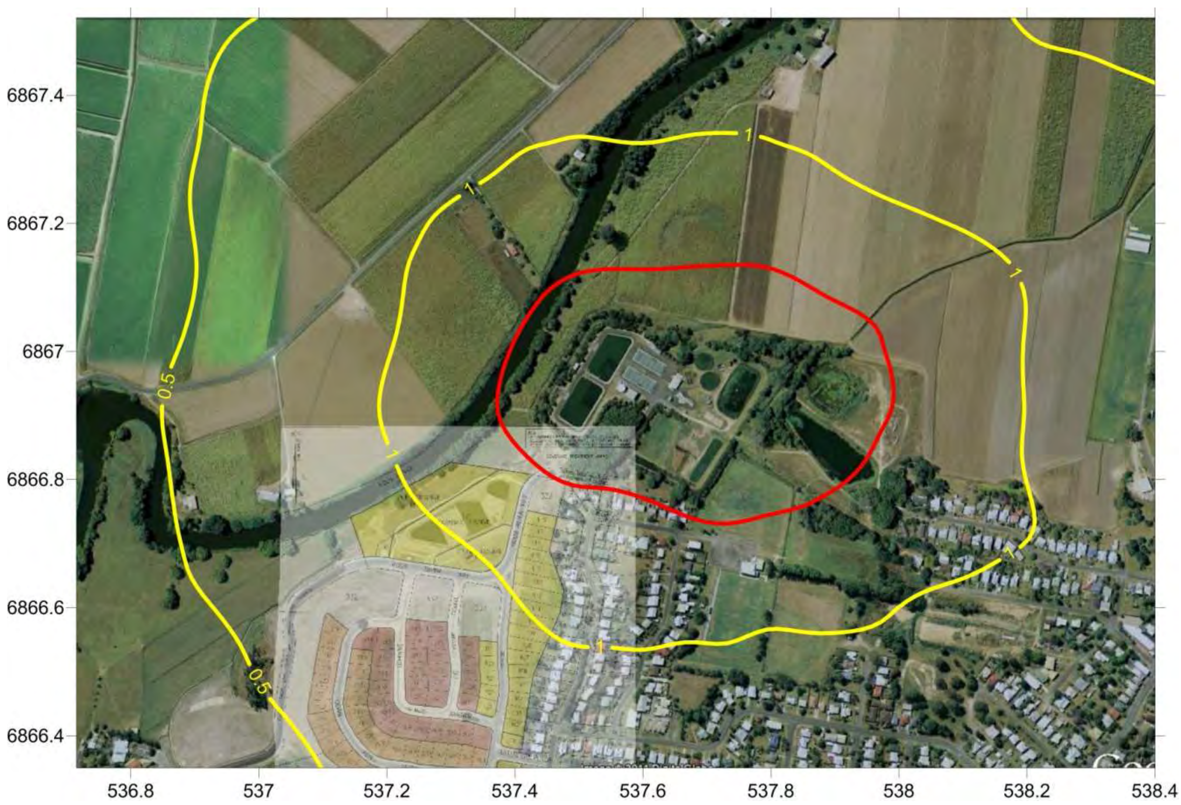
Given that the proposal is a new residential development in a large existing town, the odour criteria used in the assessment is the most stringent, $C_{99\ 1sec}$ = 2 ou.

5.2 Peak to Mean

To determine more rigorously the ratio between the one-second peak concentrations and three-minute and longer period average concentrations (referred to as the peak to mean ratio) that might be predicted by a Gaussian dispersion model, the Office of Environment and Heritage (formerly DECC) commissioned a study by Katestone Scientific Pty Ltd (1995, 1998). This study recommended peak to mean ratios for a range of circumstances. For area sources in the near field, as applies in this case, a conservative constant peak to-mean ratio of 2.5 was applied for all conditions.

6 MODELLING RESULTS

The results of the modelling are shown below in Figure 6-1. The results are consistent with what was observed during the site visit, in that the levels of odour in and around the plant were relatively low. Given the population density around the plant, if it the plant were creating high levels of nuisance, it would manifest itself through complaints. This does not appear to be the case.



Species: Odour	Location: Murwullimbah	Scenario: Existing Operation	Percentile: 99th	Averaging Time: 1 sec
Model Used: CALPUFF v6.262	**Units:** ou	**Guideline:** 2 ou	**Met Data:** 2008 CALMET-Generated	**Plot:** M.Fogarty

Figure 6-1: Predicted Odour Concentrations

7 CONCLUSION

A comprehensive odour modelling study has been performed for the Murwillumbah STP.

The results of the modelling indicate that the plant is likely to comply with the relevant NSW odour criteria ($C_{99\ 1sec}$ = 2 ou) on the northern most edges of the proposed development site. This does not mean that no odour will be detected, but during most of the year odour levels will be low under normal operating conditions.

Irrespective of the proposed development, there is however an obvious risk to the existing houses closest to the STP should the STP increase its emissions. However, given the population density in this area (i.e. the number of existing houses) it is likely that Council would be required to make arrangements (i.e. ensure mitigation measures are appropriate or upset conditions are rectified) to mitigate elevated odour releases in any case. Therefore, based on the modelling assessment, the development of the land to the south of Lots 131-133 (reserves) and Lot 332[d] (see Figure 2-1) is unlikely to present a constraint to the operation of the STP, as there is a sufficient buffer between the STP and the proposed residential development.

---

[d] As defined by the Master Plan Rev 1 TSC Approved 23-9-09 supplied by Newland to PAEHolmes. Lot 332 consists of four lots, with the 332 lot referred to here being the most northernly of the four.

The odour contour touches the most northern edge of Lot 332 and therefore may not be suitable for development.

8 REFERENCES

Hurley, P. (2008a). TAPM V4. Part 1: Technical Description - CSIRO Marine and Atmospheric Research Paper No. 25. Aspendale, Victoria: CSIRO Marine and Atmospheric Research.

Hurley, P. (2008b). TAPM V4. User Manual - CSIRO Marine and Atmospheric Research Internal Report No. 5. Aspendale, Victoria: CSIRO Marine and Atmospheric Research.

Hurley, P. (2008). TAPM V4. Part 2: Summary of Some Verification Studies- CSIRO Marine and Atmospheric Research Paper No. 26. Aspendale, Victoria: CSIRO Marine and Atmospheric Research.

Katestone Scientific Pty Ltd (1995). "The evaluation of peak-to-mean ratios for odour assessments" Volume 1 - Main Report, May 1995

Katestone Scientific Pty Ltd (1998). "Peak-to-Mean Concentration Ratios for Odour Assessments".

Luhar, A. K. & Hurley, P. J. (2003). 'Evaluation of TAPM, a prognostic meteorological and air pollution model, using urban and rural point-source data', *Atmospheric Environment*, vol. 37, no. 20, pp. 2795-2810.

NSW Office of Environment and Heritage (2005). "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", August 2005

NSW Office of Environment and Heritage (2006). "Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW". November, 2006.

Scire, J.S., Strimaitis, D.G. & Yamartino, R.J. (2000a). *A User's Guide for the CALPUFF Dispersion Model (Version 5),* Earth Tech, Inc., Concord, MA.

Scire, J., F. Robe, et al. (2000b). A user's guide for the CALMET meteorological model.

APPENDIX A

Odour Sampling Results

A.1

project ID	**05898**
issue number	**1**
client	**PAE Holmes**
issue date	**18th April 2011**
testing date	**14th April 2011**
contact	**Mr. Geordie Galvin**

newEQ is part of the Pacific Environment Limited group of companies
www.pelgroup.com

New Environmental Quality
P.O. Box 119
Coopers Plains Qld. 4108
ABN: 56 115 736 046

Area odour emissions monitoring conducted for PAE Holmes from the Murwillumbah Sewage Treatment Plant

This report provides potentially sensitive information to the reader and as such should be considered a ***confidential document***. All recipients are required to treat this report as confidential. It is for the sole use of PAE Holmes and those granted permission by PAE Holmes only.

This report is an initial release

Prepared by:

David Arbuckle BE (Hons)
Manager

New Environmental Quality Pty Ltd.
Unit 1, 20 Meadow Avenue, Coopers Plains, Qld. 4108
: +61 7 3452 4700

TABLE OF CONTENTS

Contents

List of Tables

INTRODUCTION

New Environmental Quality (newEQ) was commissioned by PAE Holmes to sample, collect and analyse odour samples from various sources at the Murwillumbah Sewage Treatment Plant located in Northern NSW.

In total, three sources were sampled with duplicate samples being collected from each area source. A flux hood sampling device was used in accordance with AS4323.4 and samples were analysed within 30 hours of collection via AS4323.3. Samples were collected on the 14th April 2011.

newEQ was responsible for the collection and analysis of all samples, as detailed in table 1 and 2. The collected samples remained sealed and preserved in the appropriate manner. Upon return to the laboratory the samples were prepared and analysed by the correct methodologies.

All sampling and analysis was conducted by newEQ unless otherwise stated. The results presented in this report are related to one or more reference calibrations held by newEQ.

TEST METHODS

Table 1: Sources tested

Source Tested	Type of Sample	Number of samples	Analysis Required
Sludge Lagoon	Flux Hood	2	Odour
Aeration Basin	Flux Hood	2	Odour
Effluent Lagoon	Flux Hood	2	Odour

Table 2: Test Methods

Parameter	Collection Method	Analysis Method	Analysis Note	Sampling Note
Odour	AS4323.4	AS4323.3	1	See table 4

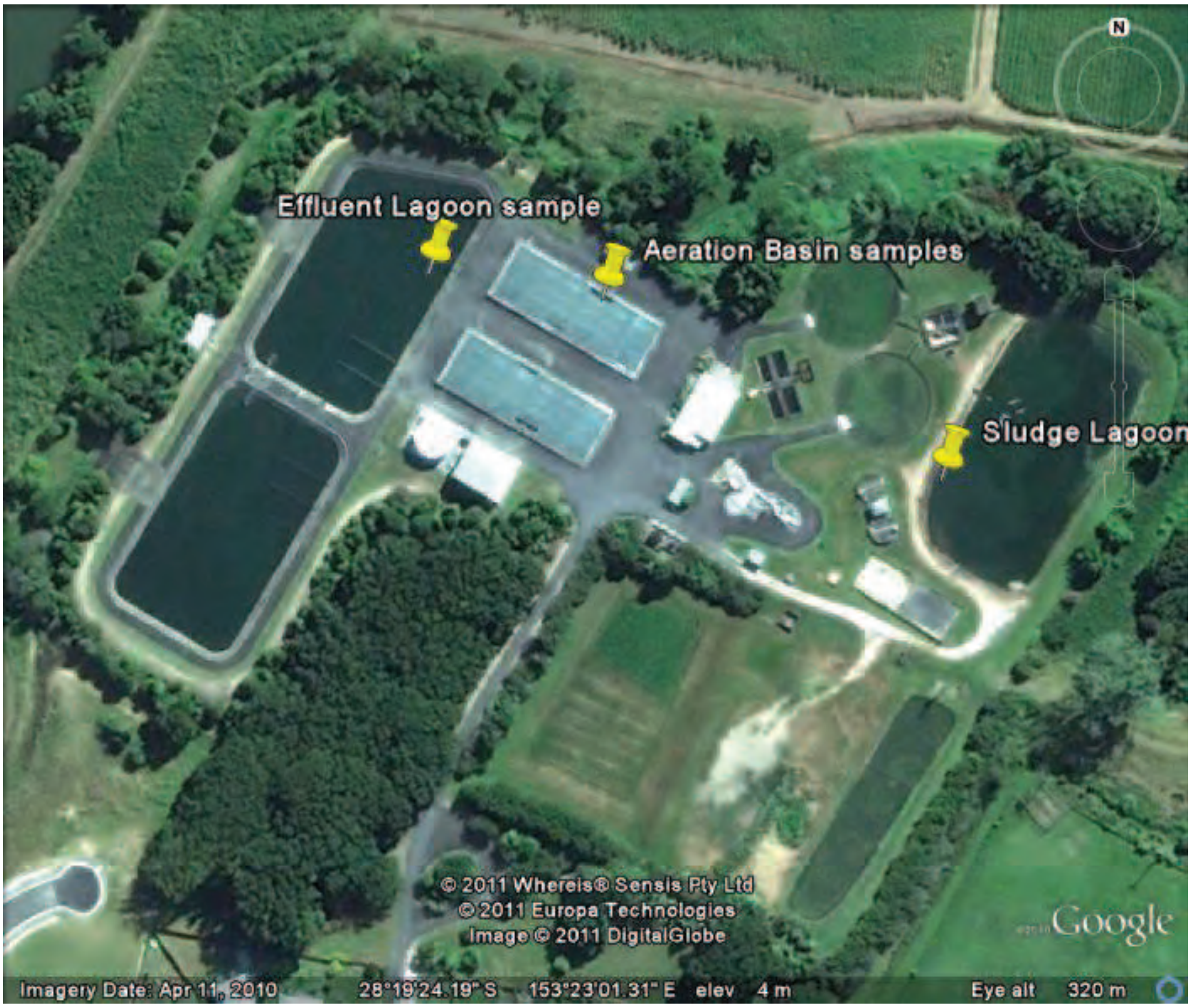
Table 3: Analysis Notes

Analysis Note	Company	NATA Accreditation ID	Report Number
1	newEQ	na	05898 Murwillumbah report -1

Table 4: Sampling Notes

Source	Comment
Sludge lagoon	20 x 60m lagoon ducks swimming on lagoon sludge broken up across surface of lagoon
Aeration Basin	sampled while aeration taking place expected to have strongest smell first sample was taken half and half with aeration on and off second sample was taken with aeration on
Effluent Lagoon	small amounts of algae like material on surface ducks swimming on lagoon

Figure 1: Sample locations



QUALITY ASSURANCE & QUALITY CONTROL (QA/QC)

newEQ operates within a quality system based upon the requirements of ISO17025. Our quality system defines specific procedures and methodologies to ensure any project undertaken by newEQ is conducted with the highest level of quality given the specific confines of each project. These procedures address such facets as:

- project management
- equipment calibration and maintenance
- adherence to specific sampling methodologies
- selection of sub-contracting laboratories
- storage and freight of collected samples
- final report preparation

Table 5: Odour sampling and analysis QA/ QC

Item	Comment
Methodology	AS/NZS4323.3:2001 "Determination of odour concentration by dynamic olfactometry". Measurements were performed using dynamic olfactometry.
Sample media	Odour samples collected in Nalophan® sample bags
Sample identification	All samples are labelled uniquely on-site according to the newEQ identification procedure. Each sample has the following recorded: sample number, location, date and time, dilution and any deviations from AS/NZS4323.3:2001.
Timing	All measurements were conducted within 30 hours of sampling as specified by AS/NZS4323.3:2001
Traceability	All panel results are traceable to reference standards held by newEQ.
Equipment identification	Odourlab Version 2
Conditions during analysis	Room temperature maintained at ≤25ºC ± 3ºC
Odour panel location	Unit 1/20 Meadow Avenue Coopers Plains, Queensland 4108, Australia
Reference odourant	175ppm n-butanol
Odour panel threshold	40 ou

DEFINITIONS

Table 6: Definitions

Symbol	Definition
<	The analytes tested for was not detected; the value stated is the reportable limit of detection
^{o}C	Degrees Celsius
mm	Millimetres
mb	Millibars
ml	Millilitres
Mole	SI unit that measures the amount of substance
g	Grams
mg	Milligrams (10^{-3} grams)
µg	Micrograms (10^{-6} grams)
Am^3	Gas volume in cubic metres at measured conditions
Nm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa)
sec	Second
min	Minute
mmH_2O	Millimetres of water
STP	Standard temperature and pressure (0°C and 101.3 kPa)
OU	Measured odour concentration/threshold
OU/m^2.min	Odour units emitted per square meter of surface area per minute
Na	Not applicable
TNMVOC	Total non methane volatile organic carbons. Expressed as ppm isobutylene
DMS	Dimethyl sulphide
RSH	Mercaptans
NH_3	Ammonia
is	Insufficient sample

CALCULATION OF RESULTS

Table 7: Odour sampling results

Odour Lab ID	Sample ID	Specific ID	Location of Sample	Test Parameter/s	Sweep Air Flow Rate	Source Penetration Depth	Ambient Temp	Flux Temp	Barometric Pressure	Equil Start Time	Equil Finish Time	Sample Start Time	Sample Finish Time	Sample Flow Rate	Odour Unit	Odour Emission Rate		Equil Time	Sample Time	WIDTH	LENGTH	Odour Emission Rate
					lpm	mm	oC	oC	mb	hh:mm	hh:mm	hh:mm	hh:mm	< lpm	OU/m3	OU/m2/min	OU/m2/sec	min	min	m	m	OU/sec
1	-1	-1	Sludge lagoon	odour	5.0	50.0	27.0	37.4	1011.0	12:55 PM	1:24 PM	13:24	13:34	2.5	409	15.7	0.262	0:29	0:10	40	80	839.0
2	-1	-2	Sludge lagoon	odour	5.0	50.0	27.0	37.4	1011.0	1:00 PM	1:25 PM	13:37	13:47	2.5	409	15.7	0.262	0:25	0:10	40	80	839.0
3	-2	-1	Aeration basins	odour	5.0	5.0	27.4	27.4	1011.0	1:53 PM	2:18 PM	14:18	14:28	2.5	333	12.8	0.213	0:25	0:10	40	50	426.9
4	-2	-2	Aeration basins	odour	5.0	5.0	27.4	27.4	1011.0	1:56 PM	2:28 PM	14:30	14:40	2.5	147	5.7	0.094	0:32	0:10	40	50	188.5
5	-3	-1	Effluent Lagoon	odour	5.0	50.0	27.0	36.4	1012.0	2:45 PM	3:11 PM	15:11	15:21	2.5	98	3.8	0.063	0:26	0:10	40	140	351.8
6	-3	-2	Effluent Lagoon	odour	5.0	50.0	27.0	36.4	1012.0	2:50 PM	3:21 PM	15:21	15:34	2.5	80	3.1	0.051	0:31	0:13	40	140	287.2

Table 8: Document Control

Report ID	Date	Comment	Author	Released to
05898-1	18th April 2011	Initial release	DA	GG