Odour Impact

North Penrith

Assessment report

Summary

An odour assessment is required as part of the EA for a proposed residential and mixed use development of the North Penrith site, part of which is within the recommended 400m buffer zone of the Penrith Sewage Treatment Plant (Penrith STP).

The odour assessment indicates the potential for nuisance odour impacts, from the existing Penrith STP and from a proposed onsite sewage pumping station (SPS), would be minimal.

Objectives

The objectives of the odour impact assessment are to assess the potential encroachment of residential development on the recommended 400m buffer zone for the Penrith STP and assess the potential impact from the proposed SPS located in a relatively central position on the development site.

Methods and findings

A review of the most recent modelling assessment for Penrith STP was used to determine if there was any impact from the encroachment of the development site into the recommended 400m buffer zone. A screening modelling assessment for the proposed SPS was conducted for a worst case emissions scenario.

Consultation

Consultation with Sydney Water was undertaken to ensure odour impacts from the Penrith STP were adequately assessed.

Conclusions

The results presented for the recent modelling of odour from the Penrith STP indicate the odour impact extends no more than approximately 50m from the plant and, therefore, no impacts are expected on the development site. A screening modelling assessment for the proposed SPS indicates that, under a worst case emissions scenario, the potential for odour impact at the development site and in the Penrith Training Depot will be minimal.

Recommendations

Recommendation 1. It is recommended the final location of the SPS is selected and/or the immediate urban environs of the SPS so designed as to achieve a reasonable buffer zone from sensitive receptors viz, residential dwellings.

Contents

1. Objectives of assessment

At a glance

An odour assessment is required as part of the EA as part of the development site is within the recommended 400m buffer zone of the Penrith STP.

The development will also include a sewage pumping station on-site, and the potential odour impact from this will also be assessed.

Introduction

Landcom is currently preparing an Environmental Assessment (EA) under Part 3A of the Environmental Planning and Assessment Act, for:

- the Concept Plan application (MP 10-0075); and,
- the Project Application for Stage 1 (MP 10-078),

for the residential and mixed use development of the North Penrith site.

PAEHolmes has been engaged to prepare an Odour Impact Assessment, as part of the EA,

An overall Concept Plan for the site has been developed with a staged project development being the preferred approach. The Director General's Requirements (DGRs) for Environmental Assessment have been issued and, although air quality and odour were not included as key issues, a small section of the northern portion of the site falls within the recommended 400m buffer zone for the Penrith sewerage treatment plant (Penrith STP).

It is understood the first stage of development, being the part of the site covered by the Stage 1 Project Application, will have a Sewage Pumping Station (SPS). The potential for odour impacts from this SPS will also be assessed.

Scope of Work

An odour impact assessment is required to assess:

- the potential encroachment of residential development on the recommended 400m buffer zone for Penrith STP; and
- the potential impacts from the SPS located in a relatively central position on the development site.

The scope of work to achieve this is:

- conduct an Air Quality Impact Assessment in general accordance with the NSW DECCW "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (**NSW DEC, 2005**);
- describe the ambient receiving environment, including prevailing meteorological conditions and nearby sensitive receptors;

- assess the potential odour impact associated with the operation of the Penrith STP on new sensitive receptors proposed for the site;
- assess the potential odour impact associated with the operation of the SPS for existing and new sensitive receptors in the area; and
- consideration of management measures to control any impacts.

2. Site analysis

At a glance

Landcom proposes a mixed use development of the North Penrith site on approximately 40ha of largely vacant land north of Penrith CBD.

Local Setting

The proposed development site is located on the North Penrith Defence Site, located on a parcel of land between Penrith train station and Coreen Avenue.

The site is approximately 380m south of the Penrith STP, with an industrial park providing a buffer between Coreen Avenue and the STP.

The development site is bounded by residential to the east, the railway corridor to the south (with mixed use commercial/ residential beyond), commercial/ light industrial to the west and light industrial to the north.

A Commuter Car Park will be constructed to the south west of the site to replace the current temporary car park. The Department of Defence will continue to occupy the Penrith Training Depot (PTD) on the southern boundary of the site. The site is shown in **Figure 1**.

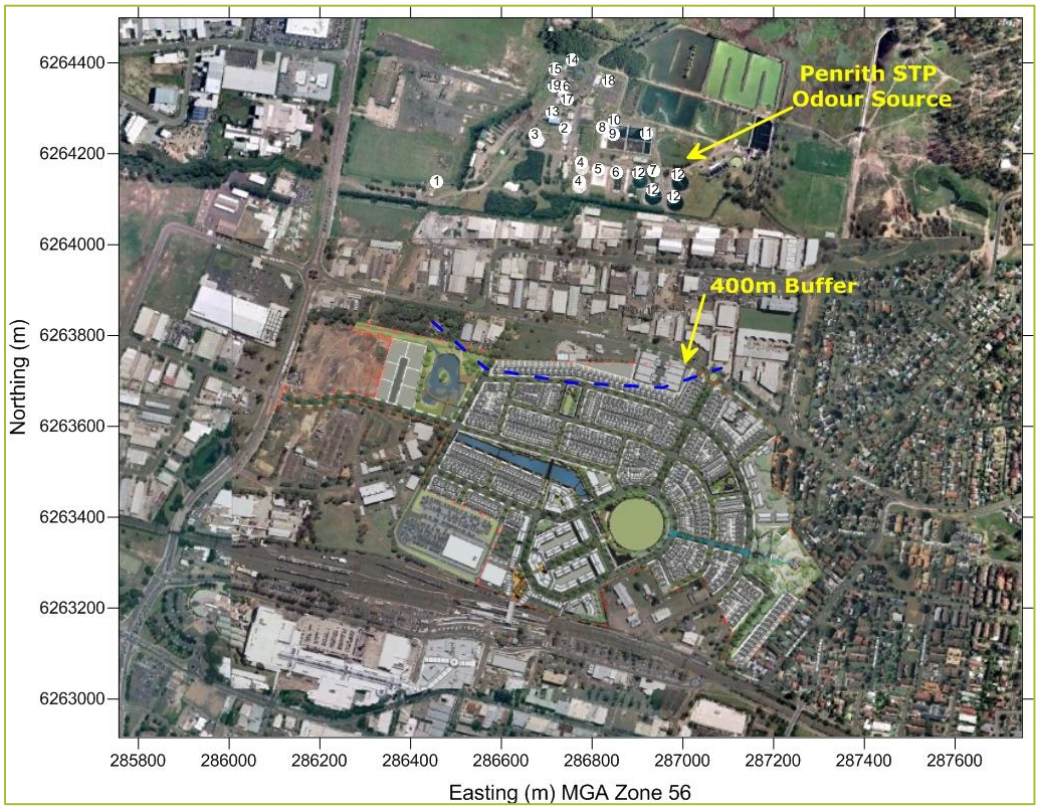

Figure 1: Site and Locality

Prevailing Meteorology

Wind roses for the Bureau of Meteorology (BoM) site at Penrith Lakes (2009) and the Penrith STP site (1992 – 1995) are presented in **Figure 2**. Winds are aligned along the south-southwest and north-northeast axis which is indicative of the influence of terrain inducted flows due to the proximity to the Blue Mountains.

The meteorological data collected at the STP indicates that calm conditions (wind speeds less than 0.5 m/s) are relatively frequent, at about 20% of the time. It is under these conditions, when dispersion is least efficient, that odour impacts from the STP could be expected to be greatest.

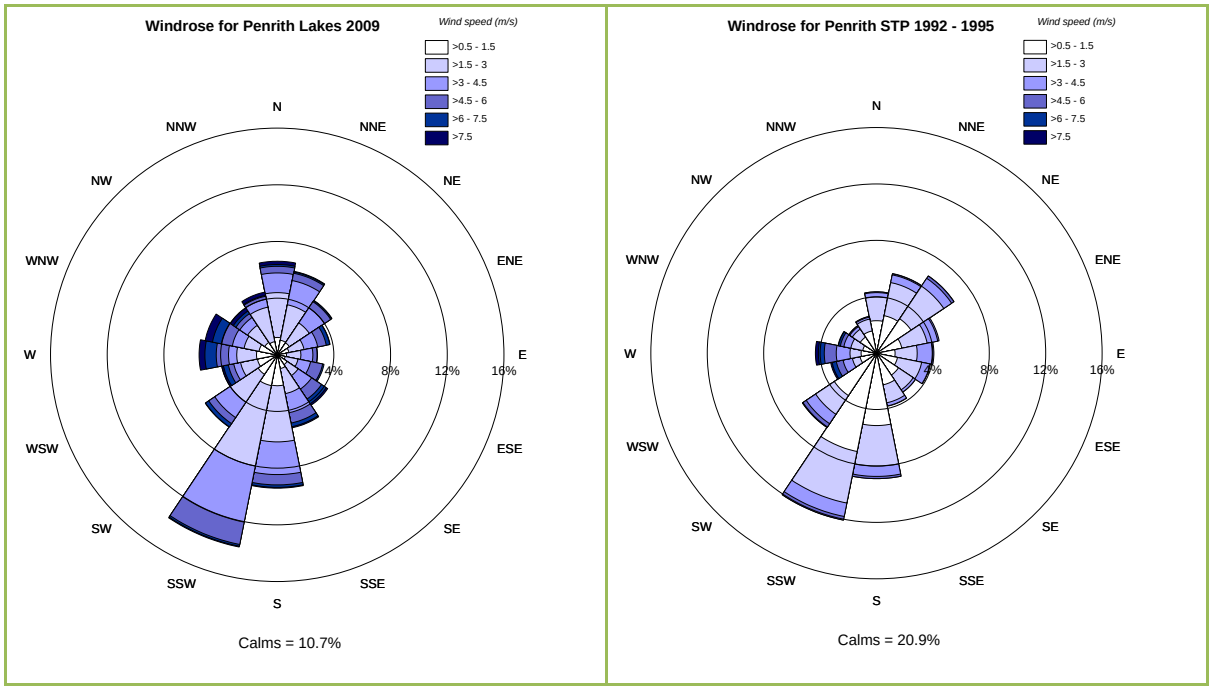

Figure 2: Wind Roses

Adjoining land uses

Adjoining land uses include:

- the Penrith Training Depot abutting the railway line to the south east;
- the Museum of Fire and light industrial uses to the north and west;
- the main western rail line to the south;
- residential uses to the east; and
- a temporary commuter car parking area next to the railway station (with a new Commuter Car Park due to be constructed by Penrith City Council).

3. Regulatory context

At a glance

Odour impacts in NSW are assessed against impact assessment criteria prescribed by the NSW DECCW. Odour criteria take into account population density in the area and based on the area around the site, the odour goal for this development would be 2 OU, not to be exceeded for more than 1% of the time.

Odour Buffer Zones

In March 1989, the Department of Urban Affairs and Planning issued guidelines for buffer areas around sewage treatment plants (Circular No. E3 (**DUAP, 1989**)). The guidance recommended the creation of buffer areas, through local environmental plan, of at least 400m from sewage treatment plants.

In April 2006, the Water Directorate issued guidelines for land use planning within buffer zones (**Water Directorate, 2006**). The guidelines recognised the inflexibility of a rigid buffer zone and recommended a risk based approach to investigating land use planning around existing sewage treatment facilities.

POEO Act

The *Protection of the Operations Act 1997* (POEO Act) is the key piece of environment protection legislation administered by NSW Department of Environment, Climate Change and Water (DECCW).

Under the POEO act "*the occupier of any premises at which scheduled activities are carried on under the authority conferred by a licence must not cause or permit the emission of any offensive odour from the premises to which the licence applies*".

NSW DECCW Guidance

Odour impact assessment in NSW is guided by the DECCW "Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales" (NSW DEC, 2005) (the Approved Methods).

Odour assessment and management in NSW is guided by:

- NSW DEC (2006) "Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW". November, 2006; and
- NSW DEC (2006) "Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW". November, 2006.

Odour Performance Goals

The determination of air quality goals for odour and their use in the assessment of odour impacts is recognised as a difficult topic in air pollution science. The topic has received

considerable attention in recent years and the procedures for assessing odour impacts using dispersion models have been refined considerably.

There is still considerable debate in the scientific community about appropriate odour goals as determined by dispersion modelling. The DECCW has developed odour goals and the way in which they should be applied with dispersion models to assess the likelihood of nuisance impacts arising from the emission of odour.

There are two factors that need to be considered:

- what "level of exposure" to odour is considered acceptable to meet current community standards in NSW; and
- how can dispersion models be used to determine if a source of odour meets the goals which are based on this acceptable level of exposure.

The term "level of exposure" has been used to reflect the fact that odour impacts are determined by several factors the most important of which are:

- the Frequency of the exposure;
- the Intensity of the odour;
- the Duration of the odour episodes; and
- the Offensiveness of the odour, (the so-called 'FIDO factor').

In determining the offensiveness of an odour, it needs to be recognised that for most odours the context in which an odour is perceived is also relevant. Some odours, for example the smell of sewage, hydrogen sulfide, butyric acid, landfill gas, are likely to be judged offensive regardless of the context in which they occur. Other odours, such as the smell of jet fuel, may be acceptable at an airport, but not in a house; and diesel exhaust may be acceptable near a busy road, but not in a restaurant.

In summary, whether or not an individual considers an odour to be a nuisance will depend on the FIDO factors outlined above and although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable. Odour goals need to take account of these factors.

The *Approved Methods* include impact assessment criteria for complex mixtures of odorous air pollutants and have been refined by the DECCW to take account of population density in the area. **Table 1** lists the odour impact assessment criterion to be exceeded not more than 1% of the time, for different population densities.

Table 1: Impact Assessment Criteria

Population of affected community	Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants (OU, nose-response-time average, 99th percentile)
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (2000) and/or schools and hospitals	2

The difference between odour goals is based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For a given odour level, there will be a wide range of responses in the population exposed to the odour. In a densely populated area there will, therefore, be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area.

Based on the population density for the area around the proposed site, the odour goal for this project would be 2 Odour Units (OU).

4. Methods and results

At a glance

Based on a review of the most recent modelling assessment for the Penrith STP, the potential for odour impacts at the site were shown to be minimal.

The predicted odour from the SPS, under a worst case emissions scenario, will also be minimal.

Assessment Approach

The encroachment of the site into the recommended 400m buffer from the Penrith STP is assessed to determine if the proposed land use for the development would be impacted by odour from the STP. The assessment approach is to review the most recent modelling assessment for the Penrith STP and to compare the odour predictions to determine the extent of potential impact on the development.

Also, the potential odour impact from the operation of the on-site SPS is assessed for existing and new sensitive receptors in the area. A screening modelling assessment is performed to predict the odour impact from the SPS.

Penrith STP

The Penrith STP is owned and operated by Sydney Water, and consists of primary, secondary and tertiary treatment.

An odour impact assessment report for the Penrith STP has recently been completed (**MWHPB, 2010**). The assessment used dispersion modelling to investigate potential improvements in ventilation and odour control at the STP.

Two modelling scenarios were examined, one for the existing odour controls on site and one for potential improved ventilation and odour controls. The results presented for existing operations (and existing odour control) are discussed in the report.

Overall Review of MWHPB Report

To have confidence in the results presented in the MWHPB report, it is necessary to review the report and ensure the approach is in accordance with the *Approved Methods*. While a detailed review of the report is not presented, the following key areas are discussed.

- characterisation of dispersion conditions and choice of dispersion model;
- estimation of odour emissions and derivation of odour emissions inventory; and
- presentation of results and compliance assessment.

Dispersion modelling uses the CALMET/ CALPUFF modelling system, which is generally considered superior to simple Gaussian dispersion models such as AUSPLUME, which assume that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in complex flow

situations, such as complex terrain or coastal environments, the meteorological conditions may be more accurately simulated using a wind field model such as CALMET/ CALPUFF.

CALPUFF also has the ability to deal with calm wind conditions, and can grow the plume through diffusion. These calm conditions are important for odour impacts and simple steady state Gaussian dispersion models often break down during low wind speeds due to the inverse wind speed dependence of the plume equations. The choice of CALMET/ CALPUFF dispersion model provides additional confidence in the results presented.

The dispersion conditions are characterised well in the report, with surface observations input from four nearby BoM stations and upper air data sourced from prognostic MM5 meteorological model. All other model inputs (terrain, land use, building wake effects) appear to be robust.

To ensure confidence in the model predictions, the odour emission rates for each source at the STP need to be accurate. The odour emissions inventory was derived based on odour monitoring conducted at the site during December 2009 and January 2010, and supplemented with odour emissions data from the Sydney Water's Odour Database. A comparison between the odour emissions inventory and the odour database for Penrith indicates that all emission rates appear to be reasonable and mostly within in the range previously measured at Penrith STP.

The only exception to this is the specific odour emission rate (SOER) for the Biofilter outlet/ surface which appears to be quite low when compared to previous measurements taken at Penrith STP. For example, the SOER presented in the report is approximately 0.03 $OU.m^3/m^2/s$ whereas the SOERs for the same source in the Sydney Water database ranges from 0.2 to 2.3 $OU.m^3/m^2/s$ (calculated from the odour concentration based on flow rate to the flux hood of 5 l/min).

However, the odour character from Biofilters is typically different from other site process odours, and the contribution of this source may not be as significant to cumulative offsite odour impacts.

Summary of Results

Odour results are presented for the existing STP operation, based on the 99th percentile odour prediction. Dispersion model predictions for 1-hour averages are adjusted for nose-response times (1 second) based on near-field peak to mean ratios, in accordance with the *Approved Methods*.

The results presented for the existing scenario indicate that 2 OU (99th %) impact assessment criteria extends no more than approximately 50 m beyond the boundary of the Penrith STP, into the existing industrial area to the south of the development site.

Onsite Sewage Pumping Station

There is a need for a relatively small scale (circa 2,000 population in the development) SPS to be located in a relatively central position on the development site.

The potential odour impact from the pumping station is assessed for the adjoining land uses (PTD) and residential uses proposed for the site.

An appropriate buffer zone depends on several considerations to avoid odour nuisance duing normal operations, maintenance and unusual operations. It is generally recognised the design of SPSs by Sydney Water coupled by its good operating practices necessitates only a reasonably small buffer distance around the SPS (principally associated with maintenance activities).

Odour emissions from the SPS will be variable, depending on flow. The resultant odour impact will also vary, depending on time of the day and associated meteorological conditions. For example, during night time (stable, calm conditions), dispersion would be poorest, however, the odour emissions during these times may be minimal.

To determine the potential odour impact from the operation of the SPS, a simple worst case screening modelling assessment was conducted. The modelling uses the dispersion model CALPUFF (discussed above) but utilises a single surface station meteorological data file as input. This screening approach is typically referred to as running CALPUFF in two dimensional mode. The input data was sourced from an existing meteorological input file which was developed based on historical measurements at Penrith STP (refer **Figure 2**).

A review of the Sydney Water odour database for measurements taken from SPS vents indicates that significant variation can occur, with measured odour concentrations varying from 76 OU to 21,635 OU (refer **Figure 3**). To provide a conservative estimate of the potential for odour impact, the average odour concentration of 3,104 OU has been used to derive an odour emission rate (OU.m3/s), based on an assumed flow from the vent. Due to an accepted repeatability for odour analysis of 30%, the average was determined to be a better statistical measure of potential odour emissions than, for example, the maximum.

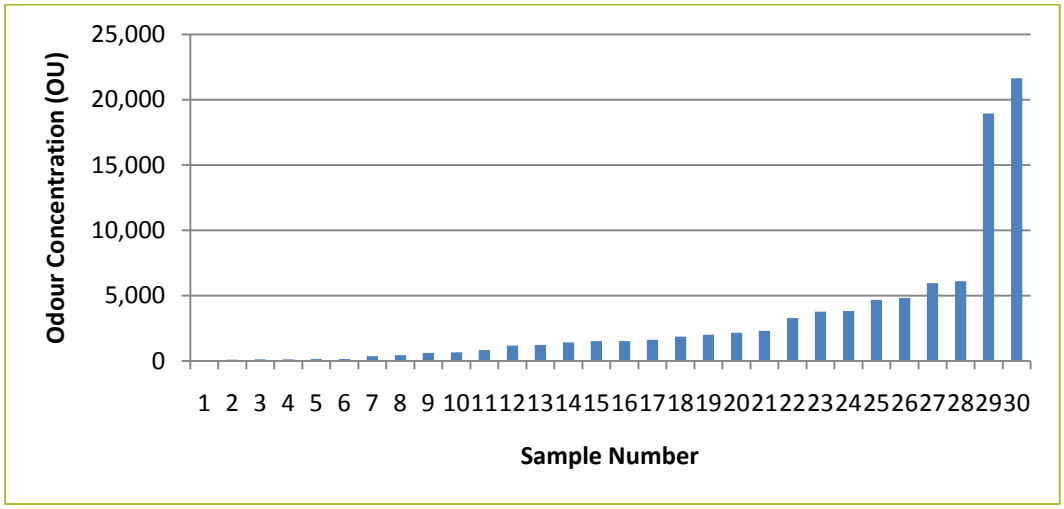

Figure 3: Odour Concentration Range from SPS

The following stack parameters were assumed:

- a stack height of 14 meters was assumed based on advice from design engineers;
- a vent diameter of 0.15 m was assumed;
- an exit velocity of 0.5 m/s was assumed (based on the assumption of passive ventilation);
- the vent temperature was assumed to be ambient and set to 293 K; and
- an odour emission rate of 27 OU.m^3/s was derived based on the average odour concentration and volumetric flow rate (m^3/s).

In accordance with the Approved Methods, a peak to mean factor of 17 for stability class A – C and 35 for stability class D – F was applied to the odour emission rate, to adjust the 1-hour mean model predictions to peak 1-second impacts. These peak to mean factors are for a wake free point source. The pumping station may have two buildings (a control building and a chemical dosing building, if required), each with a proposed height of 3 m. It is therefore assumed that the vent release stack would not be subject to building wake effects.

The results of the maximum odour concentration model predictions are presented in **Figure 4**. The results indicate the potential for odour impact from the SPS will be minimal with predicted odour levels at all locations less than 2 OU. It is noted that the maximum predicted odour concentration is presented, rather than the 99th percentile, based on the screening nature of the assessment, in accordance with the *Approved Methods*.

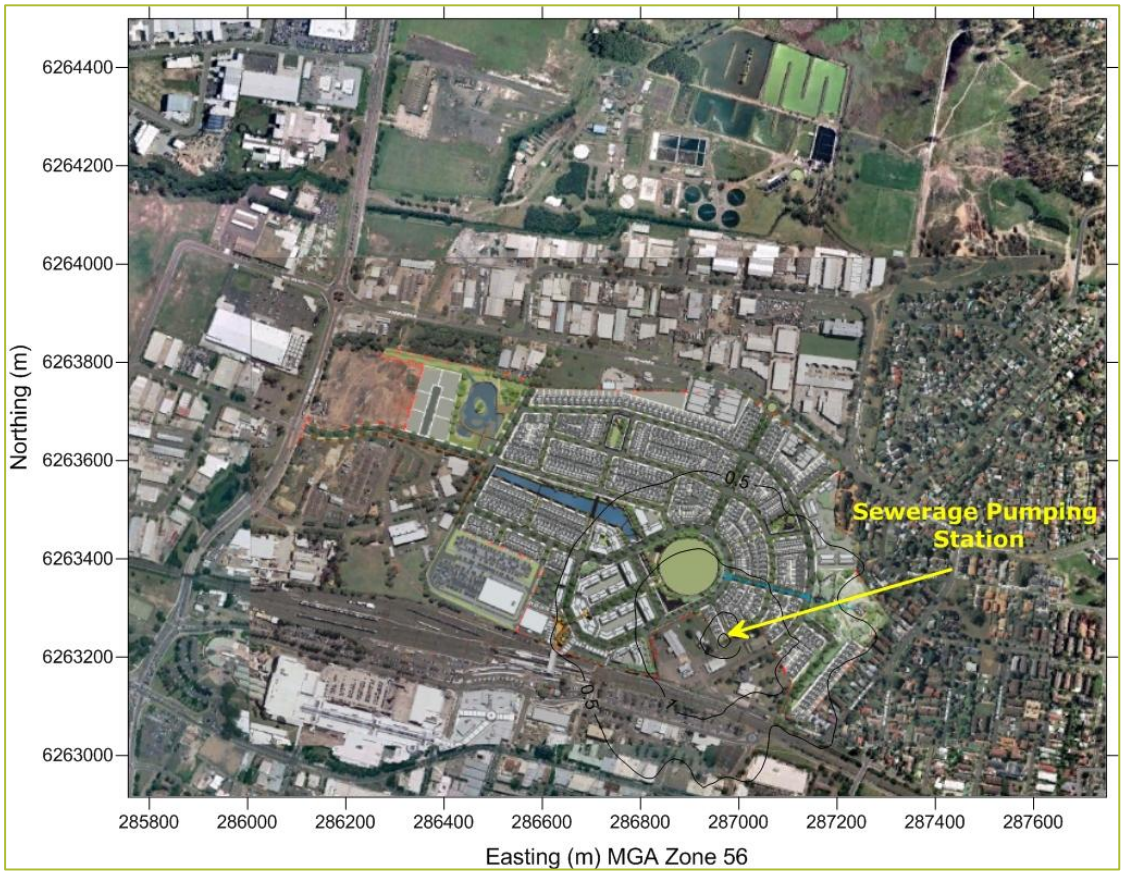

Figure 4: Predicted Odour from Pumping Station

5. Assessment

At a glance

An odour assessment indicates the potential for nuisance odour impacts, from the existing Penrith STP and a proposed SPS, would be minimal.

Penrith STP

Part of the North Penrith site is within the recommended 400m separation from the Penrith STP. The Concept Plan for the development indicates it is proposed for some residential dwellings to be within the buffer zone. Recent modelling of the Penrith STP indicates odour impacts are unlikely beyond 50m from the boundary of the STP. On the basis of this modelling, exceedances of the DECCW odour impact assessment criteria at the proposed site are unlikely to occur. It is, therefore, considered not necessary to restrict that part of the development site which extends into the buffer zone to non-residential uses.

On-site Sewage Pumping Station

A screening worst case modelling assessment indicates the odour impact from the operation of a potential SPS will be minimal. It is recommended the final location of the SPS is selected and/or the immediate urban environs of the SPS so designed as to achieve a reasonable buffer zone from sensitive receptors viz, residential dwellings.

6. References

Documents referenced in the preparation of this assessment report are:l

- DUAP (1989) Department of Urban Affairs and Planning “Circular No. E3: Guidelines for buffer areas around sewage treatment (water pollution control) plants”, 17 March 1989.
- MWHPB (2010) “Penrith STP Odour Impact Assessment”, September 2010.
- NSW DEC (2005) “Approved Methods for the Modelling and Assessment of Air Pollutants in NSW”, August 2005.
- NSW DEC (2006) “Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW”. November, 2006.
- NSW DEC (2006) “Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW”. November, 2006.
- POEO (1997) “Protection of the Operations Act”, 1997.
- Water Directorate (2006) “STP Buffer Zone Land Use Planning Guidelines”, April 2006.

Appendix 1: Glossary

Term	Meaning
BoM	Bureau of Meteorology
DECCW	Department of Environment, Climate Change and Water
DGRs	Director General's Requirements
DUAP	Department of Urban Affairs and Planning
EA	Environmental Assessment
MUD	Multi User Depot
Odour Concentration	Defined as the number of odour units for a sample of air.
Odour Unit (OU)	One odour unit (ou) is the concentration of an odour that elicits a physiological response equivalent to that elicited by one reference odour mass equivalent to 40 ppb n-butanol
OER	Odour Emissions Rate ($OU.m^3/s$)
Peak to Mean Ratios	The instantaneous perception of odours by the human nose occurs over very short time scales (~ 1 second) but dispersion model predictions are typically made for time scales equivalent to one hour averaging periods. To estimate the effects of plume meandering and concentration fluctuations perceived by the human nose, it is possible to multiply dispersion model predictions by a correction factor called a "peak-to-mean ratio". The peak to mean ratio (P/M60) is defined as the ratio of peak 1-second concentrations to mean 1-hour average concentrations.
POEO	Protection of Environment Operations Act, 1997
SOER	Specific Odour Emission Rate (OU.m3/m2/s)
SPS	Sewage Pumping Station
STP	Sewage Treatment Plant