SECTION K

REVIEW OF ENVIRONMENTAL FACTORS WATER FACTORY LOT

SECTION K – CONTENTS

WATER FACTORY COMPANY PTY LTD

Proposed
RECYCLED WATER FACTORY
at Pitt Town, NSW

IPART APPLICATION - Section K:
REVIEW OF ENVIRONMENTAL FACTORS

March, 2010

Application to:	Independent Pricing and Review Tribunal (IPART)
Applicant	Water Factory Company Pty Ltd
Prepared by:	DBL Property Level 6, 432 Kent Street Sydney NSW 2000 Ph: 02 9267 4267

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List of Stakeholders

- Applicant Water Factory Company
- Landowner Johnson Property Group

REF Consultant Team

- Project Manager DBL Property
- Planner Integrated Site Design (ISD)
- Architect Morrison Design Group
- Landscape Architect Site Image
- Ecological Consultant Parsons Brinkerhoff (PB)
- Acoustic Assessment Wilkinson Murray
- Air Quality Assessment PAE Holmes

Technical Consultants

- Permeate Partners Technical Advice & Operations Management
- GE Water & Process Technologies MBR Suppliers
- Mono Pumps Pty Ltd Pressure Sewer Systems
- PS Solutions Reticulation Engineering

Proposed Recycled Water Factory, Bootles Lane Pitt Town

Review of Environmental Factors

Water Factory Company Pty Ltd

March 2010

Review of Environmental Factors
Proposed Recycled Water Factory
Bootles Lane, Pitt Town

Prepared for

Water Factory Company Pty Ltd

Prepared by

Integrated Site Design Pty Ltd
701/247 Coward Street, Mascot NSW 2020 PO Box 6396 Alexandria NSW 2015
T:+61 2 83381722 F: +61 2 83381733 E:isd@i-site.com.au
ACN 003 930 523

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Reviewed by	Rick Bardsley-Smith, B Town Planning (Hons) Director
Declaration	The information contained in this REF is neither false nor misleading.

Revision	**Date**	**Detail**	**Authorised**	
			Name/Position	Signature
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1 Introduction

1.1 Background

The NSW Government introduced the *Water Industry Competition Act 2006* (WICA) as part of its strategy for a sustainable water future to harness the innovation and investment potential of the private sector in the water and waste water industries. WICA established a licensing regime for new entrants to the industry to ensure the continued protection of public health, consumers and the environment. The private sector is now encouraged to develop and operate water management schemes and the licensing system is governed by the Independent Pricing and Regulatory Tribunal (IPART) and the Minister for Water.

The Johnson Property Group (JPG) owns land at Pitt Town which it intends to develop for residential purposes. The Minister for Planning has given concept plan approval for a Part 3A Project over a site termed the Pitt Town Release Area. This residential release area will be developed over the next 10-15 years.

The sewerage infrastructure required to service this release area requires an upgrade to handle the additional sewerage flows. The upgraded system is described in Hawkesbury City Council's Sec 64 Contributions Plan for Sewerage Services. At the same time there is a general and significant public interest in ensuring that projected water usage by the proposed residential development is sustainable. JPG and the Water Factory Company Pty Ltd (WFC) have developed an alternative sewerage strategy to treat sewerage locally and to produce high quality recycled water for non-potable uses within the community. Hawkesbury Council resolved on the 25th August 2009 to support in principle the establishment of a separate water authority to serve the needs of the Pitt Town Release Area.

This Review of Environmental Factors (REF) has been prepared for the WFC as part of its application for the construction and operation of the Recycled Water Factory as a *water recycling facility* as defined for the purposes *of State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP), which is an *activity* under Part 5 of *the Environmental Planning and Assessment Act 1979* (EP& A Act).

1.2 Locality, Site Description and Analysis

1.2.1 Location

The site of the proposed Recycled Water Factory is on the north-west corner of the Bootles Lane and Johnson Street, Pitt Town intersection as shown in Figure 1. The land is currently described as part Lot 1062 DP 1131838 and a plan of the Deposited Plan is contained in Appendix 1. An application has been lodged with Hawkesbury Council to subdivide Lot 1062 to create an irregular shaped

allotment for the Water Factory with an area of approximately 3,125m^2. The parcel adjoins Lot 1061 which contains a sewerage pump station owned and operated by Hawkesbury City Council.

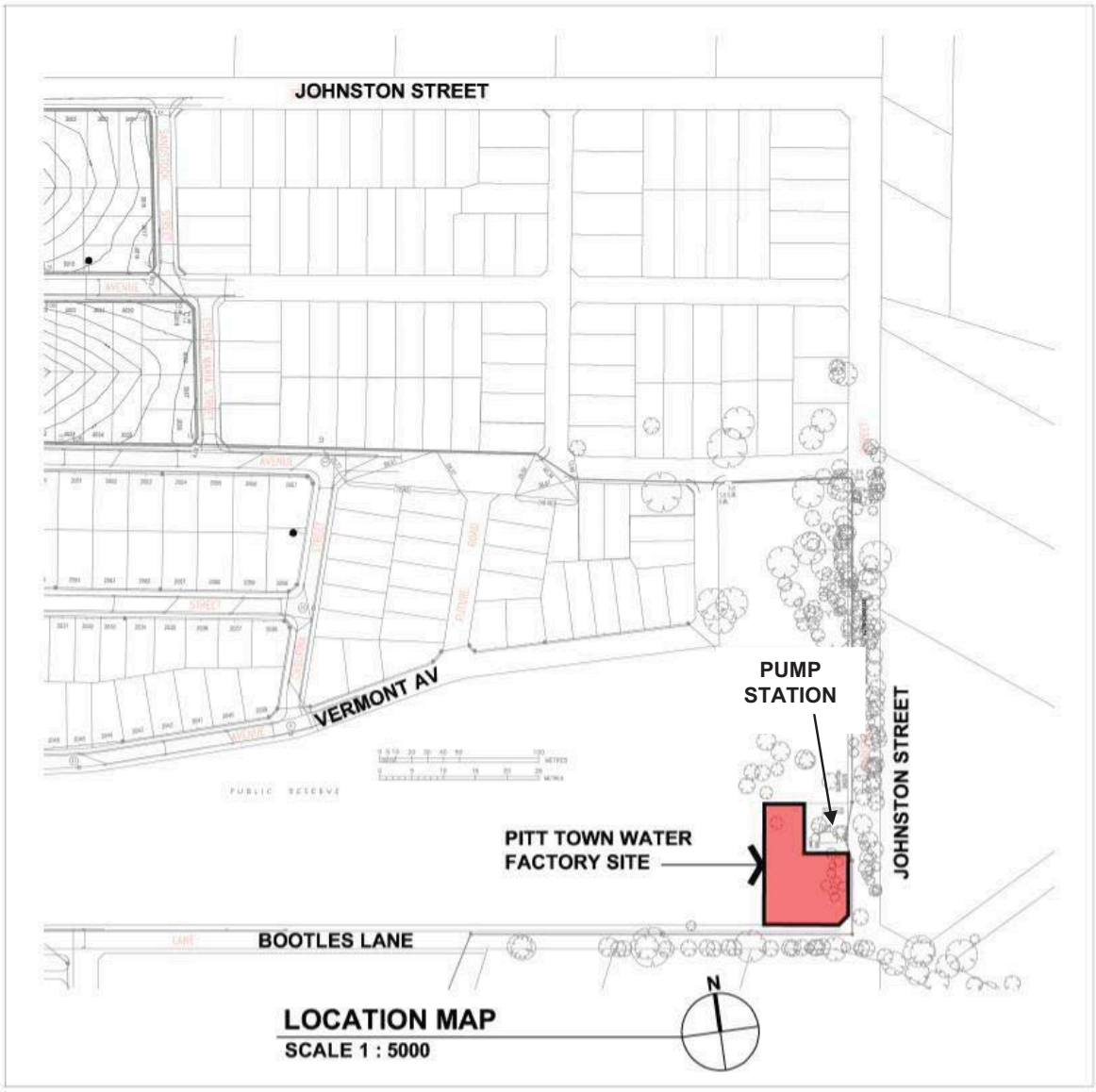


Figure 1 **Site Location**

1.2.2 Site Description

The topography of the site of the proposed Recycled Water Facility is relatively flat. The underlying geology has produced soils comprising sand and clay mixtures. Acid sulphate soils have not been identified in this area and the site is not contaminated.

The site is partially flood liable. The 1:100 AEP line is 17.3m AHD. General contour levels shown on Drawing SK01 indicate that most of the site is on the edge of the flood plain. Stormwater runoff from the Bona Vista residential area to the north travels via an overland flow path formed by a

constructed swale approximately 80m to the west of the site. Local surface water from the site will be managed by site shaping to direct overland flow to an existing culvert on Johnston Street to connect with the existing stormwater drainage system.

The subject site is located close to land in proposed lot 1067 containing a small and isolated area of Shale Gravel Transition Forest (SGTF) identified in the Sydney Basin Bioregion as an Endangered Ecological Community. This community is also listed under the Commonwealth *Environmental Conservation and Biodiversity Act 1995.* The site contains a few remnant trees of the SGTF but with very little understorey vegetation.

All services are available to the site. The roads at the frontage of the property are formed and sealed.

1.3 Description of Proposed Activity

This section of the report deals with the main elements of the proposal, which is described in more detail in the accompanying drawings prepared by Morrison Design Partnership. Figure 2 illustrates the elements and scope of the proposed development.

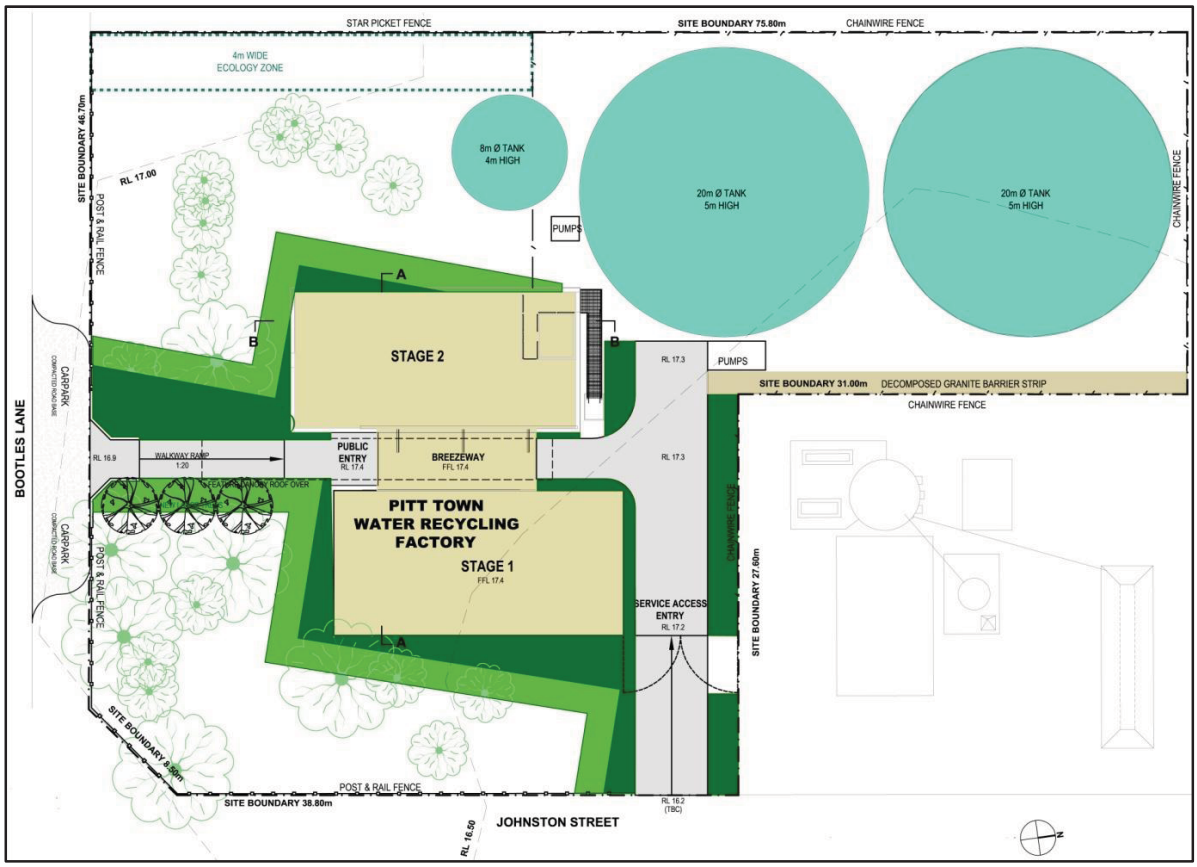


Figure 2 Site Plan

The stages shown indicate the order that the buildings will be constructed which is subject to the availability of raw material to the facility. The tanks will also be constructed in 2 stages subject to availability of raw material to process to become treated water for storage.

1.3.1 Proposed Development and Use of the Site

The proposed development is for a water recycling facility in which waste water is taken from the council sewerage system and new pressure sewer systems and treated to produce high quality water suitable for a range of uses including irrigation, clothes washing and toilet flushing purposes. Similar facilitates has been successfully installed at Darling Harbour, Mascot and the Pennant Hills Golf Course. Photograph 1 shows an existing faculty that is smaller in scale to the proposed facility. As further discussed in Section 2 of this report, the architectural treatment of the Recycled Water Factory buildings at Pitt Town responds to site specific considerations.

Photograph 1 Darling Harbour Water Recycling Facility

The proposal is fully illustrated in the accompanying architectural drawings (Drawings SK00- SK05).

The particular aspects of the Pitt Town Water Recycling Facility for which approval is sought include:

- Site works – including limited tree removal, temporary protective fencing to key site areas, site excavation to accommodate water tanks, site filling for accommodating operations buildings and driveways, minor footpath & drainage swale formation adjacent to the Bootles Lane frontage to the site, pavements for driveways and site access.

- Infrastructure works as described in Drawing SK07– including connection to SPS adjacent, pumping and pipe infrastructure and the like to operations building and tanks, electrical connections and infrastructure to building, telephone connection to building.

- Architectural components and storage tanks comprising:

  - a building for operations
  - a building for treatment tanks
  - an awning structure in a breezeway between the two buildings
  - two main water storage tanks
  - a Balance Flow tank

- Landscaping and site fencing works

- The operation of the facility will be undertaken by Water Factory Company on the following basis:

  - the plant will operate 24 hours a day, 7 days per week.

  - the goods to be stored is recycled water, which is transported by pipe system back to customers.

  - any waste water screenings will be collected and disposed by way of a trade waste agreement with a commercial agency, eg HCC, Sydney Water, a private company or a combination of these.

  - a driveway allows access to a single roller doors in the building for delivery of materials associated with the operation and for trucks for any maintenance requirements.

1.4 Built Components of the Proposed Facility

The proposed facility consists of the following key elements shown on attached architectural plans. In particular, Drawing SK01 provides a site plan of the facility and the location of the following key elements:

1.4.1 Site layout

The facility addresses Bootles Lane and has pedestrian access potential from that street, however all vehicle access to the site will be from Johnston Street. The buildings have been sited in consideration of retaining existing trees and shrubs identified as significant, and which afford opportunity to provide screening and scale to the development. Water storage tanks have been sited well back from both street frontages, behind the main facilities building and the existing Sewage Pumping Station.

1.4.2 Buildings

An operations building will house plant and equipment involved in water treatment processes. The building is approximately 20m x 10m giving an overall area of 200m^2 with a skillion roof ranging from 3m to 4.8m height across its width. The building will have a mix of colourbond and off-form concrete materials in natural and muted grey colours in its facades, and dressed with narrow bands of glass windows to soften the elevations. This contrasts with the treatment of a similar facility at Pennant Hills shown in Photography 1.

In particular the elevation from Bootles Lane aims to simulate a rural residential feel. The north elevation will carry a roller door for access to the facility from the service drive for any large components. The roof will also be of colourbond material. The building will be set at RL 17.4m, above the 1:100 year flood level, and will require filling to achieve this level.

The plant and equipment which will be housed within the Operations building will include:

- Screens
- Pumps
- Blowers
- Mixers
- Compressors
- Chemical dosing systems
- Tanks
- Electrical cabinets
- Instrumentation
- Valves and pipe work

A building enclosing treatment tanks will sit separately but aligned with the Operations building. The building is also 20m x 10m (approx 112m^2) and approx 5.2m in height above ground level to the top of the parapet which will be 1.2m above the finished roof level of the tank. The building will also sit a further 2m into the ground to reduce its height and scale. It will be constructed of off-form concrete panels in natural colours. A staircase at the rear of the building will provide access to the roof of the structure for servicing purposes.

The plant and equipment to be housed within the Treatment Plant building will include:

- Screens
- Pumps
- Diffusers
- Mixers
- Tanks
- Instrumentation, valves and pipe work

A 4m wide breezeway will separate the above buildings. The breezeway will have a canopy of steel and colourbond materials for weather protection and to visually link the buildings. The breezeway will assist in providing cover for any visitors to the site for inspections, outside of the operations areas.

The Breezeway will be secured by vertical grate fence and access gates that will provide transparency to the breezeway area, and also security with natural light and ventilation. An entry canopy will address the Bootles Lane frontage as the primary place of public entry creating a visual extension from the building directly over the entry walkway that is synonymous with creating similar entry type language for such buildings.

Services required for the operation of the facility are shown in a site services layout in Drawing SK07.

1.4.3 Tanks

Two tanks to store treated water are located to the north of the treatment plant. Capacity is 1 million litres each, and will stand 5m high above ground level, and 20m diameter. The tanks are constructed of steel and sit in a compacted earth and gravel area. Photographs 2 - 4 illustrate storage tanks at a water recycling plant at Pennant Hills Golf Course.

Photograph 2 Associated Plant

Photograph 3 Tank Separation

Photograph 4: Balance Tank at Pennant Hills

A steel tank for storage of sewage material ready for treatment (referred to as a Balance Flow Tank) will sit to the west of the treatment tanks. Its size is 8m diameter and 4m height.

The tanks will be interconnected with pipes and pumps and the like to each other, and to the treatment plant building.

1.4.4 Access and Security

A service driveway and concrete hardstand is located for access off Johnston Street. The driveway will have double access gates tied back to the building and SPS to provide security to the service area of the facility. A pedestrian walkway will provide public access from Bootles Lane.

Due to the remote location of the site, external lighting will be provided to the external areas of the building which is configured with movement sensors and light sensors to provide additional deterrent against vandalism and graffiti. CCTV monitoring of external areas may be provided for security.

General access into landscaped and areas of retained vegetation will be deterred by fencing.

1.5 BCA Classification

The BCA classification of the building is Class 8 which is defined in the BCA as

> *Class 8: a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale, or gain.*

This class includes buildings used for the processing of materials for gain. However, the following considerations are relevant:

- Classes 2-9 generally cover buildings designed for human habitation, or containing habitable rooms. The current facility will only be visited for inspection or routine maintenance purpose and is not a place of employment. Frequency of visitation will be on a daily basis or as required.

- The public will only have access to the building by arrangement.

Provision of facilities (eg toilets etc), lighting and standards will be provided as required under the BCA, of which a detailed independent review and assessment will be carried out prior to commencing construction documentation. A certification will be obtained that the development will comply with the applicable technical provisions of NSW's building law.

1.6 Landscaping and Bushland Management

A Landscape Plan for the proposal has been prepared by Site Image Landscape Architects as illustrated in Drawing LA01. The landscaping has been designed to accentuate the geometry of the building in a woodland setting, by concentrating massed planting beds adjacent to the structure and entry path. This will also deter physical access to the building facades as a deterrent to graffiti. Existing mature trees on the site are retained. A portion of the site is dedicated to management of adjacent bushland, and weed removal is a component of this management. Lawns of non-invasive grass species are also proposed as a means of managing weeds on the site.

The site will be enclosed by security fences across the north and west boundaries for protection of tanks. A post and rail fence will address the Bootles Lane and Johnston Street frontages. A star picket and wire strand fence will be used to delineate site property along the western boundary through areas of vegetation to be retained.

An area of 300m^2 heavily infested with blackberry thicket in a clearing nearby the site has been identified for weed removal and planting with native trees species. Locations for nesting boxes have also been identified in nearby trees off site to be placed as habitat for fauna. The land off site is owned by the Johnson Property Group who has agreed to permit these works to occur.

The section of Bootles Lane in front of the Recycle Water Factory will be reinstated to retain its rural character with a grassy berm and swale to the road edge.

1.7 Justification of the Proposed Activity

The purpose of the development is twofold:

1. To provide a secure and sustainable source of non-potable water to residential estates in the Pitt Town area; and

2. To alleviate the need for major sewerage infrastructure works at McGraths Hill arising from the development of the Pitt Town Release Area and reduce the impact of infrastructure costs on the development of new residential areas by reducing the size and cost of sewerage infrastructure in the area.

Hawkesbury Council resolved on the 25th August 2009 to support in principle the establishment of a separate water authority to serve the needs of the Pitt Town Residential Release Area.

The development is justified because:

- it directly contributes to ecologically sustainable development through a better use of an existing resource;

- the facility is designed to service a new residential release area approved by the Minister for Planning;

- the cost of the project is fully borne by the private sector;
- The development can be undertaken without an adverse impact on the environment; and
- The infrastructure provision is in accordance with existing Government Policy.

1.8 Evaluation of Alternatives

The alternative is for Hawkesbury City Council to install additional infrastructure required to move untreated sewage from the McGraths Hill sewage treatment plant to the South Windsor sewage treatment plant where there is excess capacity

In terms of a site location for the Recycled Water Factory, the proposed location is the best possible site because of its proximity to Hawkesbury City Council's sewer carrier and pump station.

1.9 Community Consultation

Community consultation has been an integral component of the approval process for the Pitt Town Release Area by JPG since the 1990's. Recently the Water Factory Company has adopted the same policy of informing neighbouring residents about the Recycled Water Factory to address any concerns they may have in the facility. WFC will continue to inform and involve its neighbours in the progress of approvals, construction and operation of the facility through face-to-face meetings and regular correspondence as required.

2 Approvals, Permits and Licences

2.1 Introduction

The proposed development and operation of the proposed Recycled Water Factory potentially requires several approvals and consents, licences, permits or other permission from various government instrumentalities in addition to planning approval under the EP & A Act.

This section outlines the relevant approvals and their legislative basis which may need to be sought. These approvals, licences etc are grouped by the Commonwealth or State Agency responsible.

2.2 Commonwealth Department of Environment (EPBC Act)

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act provides the basis for the Commonwealth Environmental Assessment process and contains provisions for the protection for matters of National Environmental Significance (NES), which include:

- Nationally threatened species and ecological communities
- Australia's World heritage properties
- Ramsar wetlands of international importance
- Migratory species listed under the EPBC Act (species protected under international agreements)
- Commonwealth marine areas
- Nuclear actions, including uranium mining
- National heritage.

Given the outcomes of the ecological investigations conducted as part of this REF, together with consideration of the above guidelines, it is unlikely that there will be a significant impact to communities listed under the EPBC Act and therefore a referral to Department of Environment, Water, Heritage and the Arts (DEWHA) for information is not required.

2.3 NSW Department of Environment, Climate Change & Water (DECCW)

The DECCW is responsible for the administration of the following Acts that are relevant to this application.

2.3.1 National Parks and Wildlife Act (NPWA) 1974

Section 90 of the NPWA requires a permit to be granted by DECC for any works likely to destroy, deface, damage or knowingly cause or permit the destruction or defacement of a relic or Aboriginal

place or object. In addition, Section 87 requires a permit where it is intended to undertake salvage excavation relating to any Aboriginal object.

A Section 90 permit under the National Parks and Wildlife Act has previously been granted by DECC in relation to the entire Bona Vista Precinct which includes the subject land. A further permit is therefore not required.

2.3.2 Protection of the Environment Conservation Act (POEO) 1991

Section 48 & 49 of the POEO Act requires that licences are required for certain activities which are identified in Schedule 1 of this Act. The following is a scheduled activity under Schedule 1 of the EP & A Act:

> ***36 Sewage treatment***
>
> *(1) This clause applies to **sewage treatment**, meaning the operation of sewage treatment systems (including the treatment works, pumping stations, sewage overflow structures and the reticulation system) that involve the discharge or likely discharge of wastes or by-products to land or waters.*
>
> *(2) The activity to which this clause applies is declared to be a scheduled activity if it has a processing capacity that exceeds:*
>
> *(a) 2,500 persons equivalent, as determined in accordance with guidelines established by an EPA Gazettal notice, or*
>
> *(b) 750 kilolitres per day,*
>
> *whichever is the greater.*

The capacity of the proposed Recycled Water factory, which is a sewerage treatment plant for the purposes of the POEO Act, will not exceed either of the threshold tests above.

2.3.3 Threaten Species Conservation Act (TSC Act) 1995

The TSCA contains provisions requiring the identification of any vulnerable or endangered flora or fauna species, populations or ecological communities associated with a proposed development. Furthermore, if that proposal is considered to have a significant impact, the TSCA requires that appropriate recovery and management strategies be implemented.

An Endangered Ecological Community is found adjacent to and on the western fringe of the subject site. The impact of the Water Recycling Facility is considered in Section 4 of this Review based on an ecological review prepared by Parsons Brinckerhoff Australia Pty Ltd (**Appendix 2)**.

2.4 NSW Rural Fire Service

The site has been mapped as fire prone land category 1 under the Hawkesbury LGA Bushfire Prone

Land Map.

Section 100B of the *Rural Fires Act 1997* (RFA) in conjunction with section 79BA of the EP&A Act, requires a 'bushfire safety authority' to be issued by the Commissioner of the NSW Rural Fire Service, for subdivision of bushfire prone land that could lawfully be used for residential or rural residential purposes or for development of bushfire prone land for a 'special fire protection purpose'.

The proposal is not for residential or rural residential purposes or for a special fire protection purpose and therefore a referral to the Rural Fire Service for a bushfire safety authority is not required.

2.5 NSW Department of Planning (DoP)

2.5.1 Heritage Act 1977

The Heritage Branch of the Department of Planning (DoP) is guided by the Heritage Council of NSW and is responsible for the administration of the *Heritage Act 1977*. Approvals must be obtained when making to changes to a heritage place listed on the State Heritage Register, or covered by an interim heritage order, or to excavate or disturb land where there is a reasonable cause to expect that a relic will be discovered or disturbed.

A search of the State Heritage Register did not disclose any items protected by the Heritage Act or the Hawkesbury LEP and no further consideration is therefore required.

2.6 Conclusion

There is no perceived need for any additional approvals.

3 Statutory Planning Context

3.1 Introduction

This section provides an overview of the planning requirements for the proposed water recycling facility under the provisions of the Environmental Planning and Assessment Act. As explained, the proposed development is an activity and does not require development consent. However, Part 5 of the EP & A Act requires that a review of environmental factors must be undertaken before an approval to undertake the proposed works has been given.

3.2 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (infrastructure) 2007 (SEPP Infrastructure) was introduced to facilitate the effective delivery of infrastructure and the provision of services in NSW. Clause 105 of SEPP Infrastructure defines a 'water recycling facility', the development proposed, as follows:

> ***water recycling facility*** means a facility for the treatment of sewage effluent, stormwater or waste water for use as an alternative supply to mains water, groundwater or river water (including sewer mining works), whether the facility stands alone or is associated with other development, and includes associated:
>
> (a) retention structures, and
> (b) treatment works, and
> (c) irrigation schemes.

The proposed Recycled Water Factory for the purposes of the SEPP Infrastructure is a water recycling facility. Clause 106(2) of the Policy provides as follows:

> (2) Development for the purpose of water recycling facilities may be carried out:
>
> (a) by or on behalf of a public authority or any person licensed under the *Water Industry Competition Act 2006* without consent on land in a prescribed zone, and
> (b) by any other person with consent on land in a prescribed zone or on any land where the development is ancillary to an existing land use.

The site is zoned Environment Protection - Agriculture Protection (Scenic) under the *Hawkesbury Local Environmental Plan 1989* and RU2 Rural Landscape under the exhibited draft Hawkesbury Standard Instrument. The RU2 Zone is a prescribed zone for the purpose of Clause 106(2) of the SEPP Infrastructure. Accordingly, the proposed Water Recycling Facility is permissible without consent but as this activity requires an 'approval' in the form of a licence under the WICA the provisions of Part 5 of the EP & A Act apply requiring a review of environmental factors (REF).

3.3 Environmental Planning and Assessment Regulations 2000

Section 111 of the EP & A Act requires that an environmental assessment of 'activities' should take into account to *the fullest extent possible* all matters affecting or likely to affect the environment . The matters listed in the EP & A Act include the effect of the activity on:

- Any conservation agreement entered into under the *National Parks and Wildlife Act 1974* and any associated plan of management; and

- A joint management agreement and/or biobanking agreement entered into under the *Threaten Species Conservation Act 1995*.

While there are no conservation agreements, plans of management, joint management agreements or biobanking agreements that apply to the proposed Water Treatment Plant, the EP & A Act further provides that the potential effect of the activity on:

(a) Critical habitat, and
(b) in the case of threatened species, populations and ecological communities, and their habitats, whether there is likely to be a significant effect on those species, populations or ecological communities, or those habitats, and
(c) any other protected fauna or protected native plants within the meaning of the National Parks and Wildlife Act 1974.

must be considered. These issues are considered in Section 4 of this review.

The general matters that must be taken into account in preparing a review of environmental factors are prescribed by Clause 228 of the Environmental Planning and Assessment Regulations 2000. This clause provides as follows:

Clause 228 What factors must be taken into account concerning the impact of an activity on the environment?

(1) For the purposes of Part 5 of the Act, the factors to be taken into account when consideration is being given to the likely impact of an activity on the environment include:
(a) for activities of a kind for which specific guidelines are in force under this clause, the factors referred to in those guidelines, or
(b) for any other kind of activity:
(i) the factors referred to in the general guidelines in force under this clause, or
(ii) if no such guidelines are in force, the factors referred to subclause (2).

(2) The factors referred to in subclause (1) (b) (ii) are as follows:
(a) any environmental impact on a community,
(b) any transformation of a locality,
(c) any environmental impact on the ecosystems of the locality,

(d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality,

(e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations,

(f) any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974),

(g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air,

(h) any long-term effects on the environment,

(i) any degradation of the quality of the environment,

(j) any risk to the safety of the environment,

(k) any reduction in the range of beneficial uses of the environment,

(l) any pollution of the environment,

(m) any environmental problems associated with the disposal of waste,

(n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply,

(o) any cumulative environmental effect with other existing or likely future activities.

3.4 Conclusion

The proposed Recycled Water Factory is a *water recycling facility* for the purposes of the SEPP (Infrastructure) and pursuant to clause 102 of the Policy this development does not require development consent. Part 5 of the EP & A Act requires that consideration be given to matters that might affect the environment before approval to an activity is given. This Review of Environmental Factors (REF) and the supporting consultant reports fulfil this requirement.

4 Environmental Impacts and Management

4.1 Environmental Issues – General

4.1.1 Built Form

The description of the built form and the proposed materials to be used are shown on Drawings SK03 to SK05.

Siting
The buildings and tanks have been sited as shown on Drawing SK01 to provide a generous setback from the adjoining roads and the ecologically sensitive area on the western boundary, behind existing established trees. As shown on Drawing SK05 the base of the treatment tanks has been partially recessed into the ground to reduce that building's height and scale, as well as utilizing existing fencing, trees and additional landscaping to screen their presence. The storage tanks have also been located in the least prominent area of the site behind the buildings and Hawkesbury City Councils sewerage pumping station.

The Operations Buildings will have a finished floor level set above the 1:100 AEP Flood Level (17.3m AHD). In order to achieve this limited amount of balanced cut and fill will be required during construction.

Because of distance of the development from surrounding residences, overshadowing is not an issue.

Built form design
The building and tanks have simple forms and materials, consistent with the architectural language of a rural residential environment. The Operations Building will have a pitched roof, and windows will appear on the facade. The building is clad and roofed in colourbond, the steel tanks of natural colour. The colour of the facility will be consistent with the built form of residences in the area.

Landscaping
Landscaping as documented in Drawing LA101 prepared by Site Image has been designed to enhance site planning of the facility The landscaping has been designed to accentuate the geometry of the building in a woodland setting, by concentrating massed planting beds adjacent to the structure and entry path. This will also deter physical access to the building facades as a deterrent to graffiti. Existing mature trees on the site are retained. A portion of the site is dedicated to management of adjacent bushland, and weed removal is a component of this management. Lawns of non-invasive grass species are also proposed as a means of managing weeds on the site.

Visual Impact
The proposed development is located is a semi-rural area. The visual impact of the development is

limited by existing vegetation in the surrounding area particularly when viewed from the north and west. The scale and form of the proposed buildings with recessed chambers and the location of the tanks to the rear of the site behind the existing sewerage facility significantly reduce the bulk and scale of the development. The use of buildings and colours sympathetic to a rural context are particularly appropriate and the activities undertaken by the Water Factory Company do not intrude on its neighbours. Finally, the contribution of the landscaping and fencing which further break up the development is such that the visual impact of the proposed development will be consistent with the existing rural residential character..

Safety and Security

Adequate measures have been taken to ensure the safety and security of the facility through its location, the design of the buildings, the security fencing and the location of the gated access ways. The facility is located adjacent to Councils existing pump station which is under constant surveillance. The building which houses the plant and equipment is a secure industrial building which is only accessible to maintenance staff, and to the public by pre-arrangement..

Sediment and Erosion Control

A sediment and erosion control plan will be prepared for the construction phase of the proposed development. This plan will ensure that sediment is removed from stormwater leaving the site as it transfers to the stormwater drainage system in the surrounding road network. The Plan will be prepared in accordance with Hawkesbury City Council's *Stormwater Management Manual*.

Stormwater Drainage

JPG has developed a Stormwater Management Plan for the Bona Vista and Fernadell Estates of the Pitt Town release area. These are part of a submission to Hawkesbury City Council under DA No. 557/2008 for the Bona Visit Trunk Drainage. The Management Plan includes implementation of a cut-off swale upslope of the proposed WRF that directs stormwater toward catchments basins to the south west of the site. AS such the stormwater falling across the site is reduced by these works.

Stormwater management on site of the WRF will be provided by an overland flow path which directs stormwater into an existing culvert on Johnston Street. Run-off from the proposed built elements will thereby be directed into the existing stormwater system in the adjoining road system. There is no increase in Stormwater generated on site due to the works.

4.1.2 Waste Minimisation and Management

The proposed facility by its nature does not generate wastes typically associated with industrial or commercial type applications. Arrangements are being made with Hawkesbury City Council for the disposal of excess recycled water and wastewater to council sewerage system.

4.2 Flora and Fauna

An ecology assessment of the Recycled Water Factory has been undertaken by Parsons Brinckerhoff Australia Pty Ltd. The assessment was based on a field survey of the site, desk-based searches of relevant databases, and the results of previous ecological assessments of the Recycles Water Factory site and adjoining lands. A copy of Parsons Brinckerhoff's assessment is contained in Appendix 2.

The assessment:

- Provides a description of the vegetation communities and flora and fauna habitats within the site;

- Determines the likelihood of occurrence of Threatened biodiversity listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occurring within the site;

- Determines whether any species, population or ecological community would be significantly affected by the proposal; and

- Recommends measures to minimise impacts on flora and fauna.

The field survey confirms that the site is marginally affected by the existence of Shale Gravel Transition Forest but that the community in this location is transitional. However, no threatened species of plant was recorded within the site although there was a moderate likelihood of the presence in the soil seedbank of a number of threatened species.

In terms of threatened species, the Cumberland Lands Snail and Little Lorikeet were recorded within the site during field surveys. From an analysis of the site it was concluded that the proposed development would not compromise important habitat of migratory species listed under the EPBC Act.

The report contains an impact assessment for TSC Act listed biodiversity and a Commonwealth impact significance assessment in Appendices A and B respectively.

The main impacts of the proposed development identified were:

- removal of a small amount of a Threatened Ecological Community which is also habitat for threatened species of plants and animals in an area of about 4m by 35m adjacent to and within the western boundary of the site. It is noted the area is also interspersed with weeds.

- removal of 13 immature and semi-mature trees and two dead standing trees

- removal of two hollow-bearing trees

These impacts would be mitigated by the adoption of a range of measures outlined in section 4.2.1 below which aim to:

- minimise construction impacts
- re-establish of locally native plant species
- protect individuals of the Cumberland land Snail and its habitat
- minimise weed invasion in retained native vegetation

With the inclusion of these mitigation measures the report concludes that *the proposal is unlikely to cause a significant negative impact on the biodiversity of the site or broader locality.*

4.2.1 Proposed Mitigation Measures

The mitigation measures recommended in the Parsons Brinckerhoff assessment, which are to be incorporated into the development, include the following measures to mitigate the potential impacts on flora and fauna:

- temporary fencing to minimise potential damage to retained trees during construction
- a pre-clearance survey for the Cumberland Land Snail involving the collection of snails and woody debris from the earthworks area, by or under the direction of an ecologist, and relocation of these to the adjacent woodland prior to the onset of construction activities
- the creation and maintenance of a buffer between the site and the adjacent woodland patch to limit edge effects and weed invasion through fencing and weed control within a 4 m wide by 30 metres long strip of modified woodland within the site boundaries
- installation of six nest boxes on live trees within and immediately adjacent to the site prior to the onset of construction activities. Nest box installation would be supervised by an ecologist and would include designs suitable for use by hollow-dependent microbats, small parrots and large parrots/medium-sized arboreal mammals. Two boxes of each type would be installed.
- monitoring of retained hollow-bearing trees for a period of three years. If retained hollow-bearing trees die during this time, three nest boxes would be installed for each tree that dies as described above.

- augmentation of the habitat of the adjacent woodland through the placement of large woody debris on the edges and within open areas under the direction of an ecologist

- removal of woody weeds and introduced grasses from a 300m^2 area of highly disturbed adjacent to the woodland patch located to the west of the site, mulching and replacement planting of this area with plant species which are native to the Threatened community.

- strategic placement of hardstand pedestrian access and landscape plantings adjacent to the existing sewerage pumping station site to prevent the spread of *Pennisetum clandestinum* (Kikuyu Grass).

4.3 Noise

An acoustic assessment of the proposed facility has been undertaken by Wilkinson Murray and a copy of this report is contained in Appendix 3.

The report notes that there are a number of residences located to the south and to the east of the site. In order to establish project specific noise criteria as required by the NSW Industrial Noise Policy (INP) the ambient noise levels relative to the potentially most affected residence were measured.

The potentially affected area is classified as Rural by the INP and the acceptable *amenity noise levels* ($L_{Aeq, period}$ dBA) from industrial sources are:

- Daytime 50dBA
- Evening 45dBA
- Night 40dBA

The recommended sleep disturbance criteria for the interval 10:00 m and 7.00 am are $L_{A1, (1minute)}$) not exceeding the $L_{A90 (15 minute)}$ by more than 15dBA.

Based on the nature of the operation of the Recycled Water factory which can operate day and night the limiting criterion is the night time criterion which was determined to be $L_{A90 (15 minute)}$ 37dBA for all residences. The sleep disturbance criterion is 52dBA during the night period.

The results from the proposed Recycled Water Factory based on the actual operating noise of a similar facility at Pennant Hills were that the proposed facility is predicted to be lower than the limiting noise criteria and there will be no loss of acoustic amenity at the potentially most affected properties.

4.4 Odour

Advice in relation to the assessment of air quality issues has been undertaken by PAE Holmes.. A copy of the advice is contained in Appendix 4.

The issue of odour is only likely to arise from one source within the waste water recycling facility - fugitive emissions from 3 pumps located at the top of the treatment tanks, at 4.5m height above ground level. Raw material is pumped to this level and passes over screens designed to capture inorganic material larger than 3mm is size from the flow as it passes into the tanks. The screens are fully enclosed, and daily maintenance will be required to remove the material from the screens and dispose.

A model of likely odour impacts has been modelled using the Department of Environment and Climate Change's odour goals and the way in which they should be applied by dispersion models.

The relevant DECC impact assessment criterion (ground-level concentration) adopted for Pitt Town and Bootles Lane was 2 ou (odour units) at the 99th percentile (ie 1% of the time). Odour units are defined by Australian Standard AS/NZ 4323.3:2001 and 2 ou is the criterion used for urban areas, schools and hospitals. Any levels equal to or less than 2ou are in compliance with the criteria, and the study points out that an odour level of less than 1 ou or less at a receiver would not be considered offensive or indeed not be noticed by the average person.

The results from the dispersion modelling indicate that ground-level odour concentrations in the surrounding residences to the facility on Bootles Lane are below 1 ou, and even multiplied by 5 times the predicted levels as a safety factor are still below 1ou, and hence well within compliance of the 2 ou odour assessment criteria. Accordingly, odour produced by the facility will not have an adverse impact on the surrounding residencies.

5 Summary of Impacts and Conclusion

The proposed water recycling facility is designed to capture and treat the sewerage flows from the new Pitt Town residential release areas which would normally be pumped to the McGrath Hill Sewerage Treatment Plan. The purpose of the Recycled Water Factory is to provide a sustainable supply of non-potable water to local residents and to substantially extend the life of existing infrastructure and also reduce the overall cost of infrastructure.

The proposed Recycled Water Factory value adds the current sewerage system by reclaiming and re-using waste water, and so reducing pressure on the current sewerage infrastructure. Consideration has been given to the location of the buildings which houses the treatment plant and the associated storage tanks to ensure that the visual impact on the surrounding residences is minimised.

Adequate measures have been introduced to ensure that noise, odour and other potential environmental impacts have been adequately addressed.

The accompanying flora and fauna assessment has indicated that the proposed facility is unlikely to cause a significant negative impact on the biodiversity of the site or of the broader locality if the recommended mitigation measures described in Section of this report are implemented.

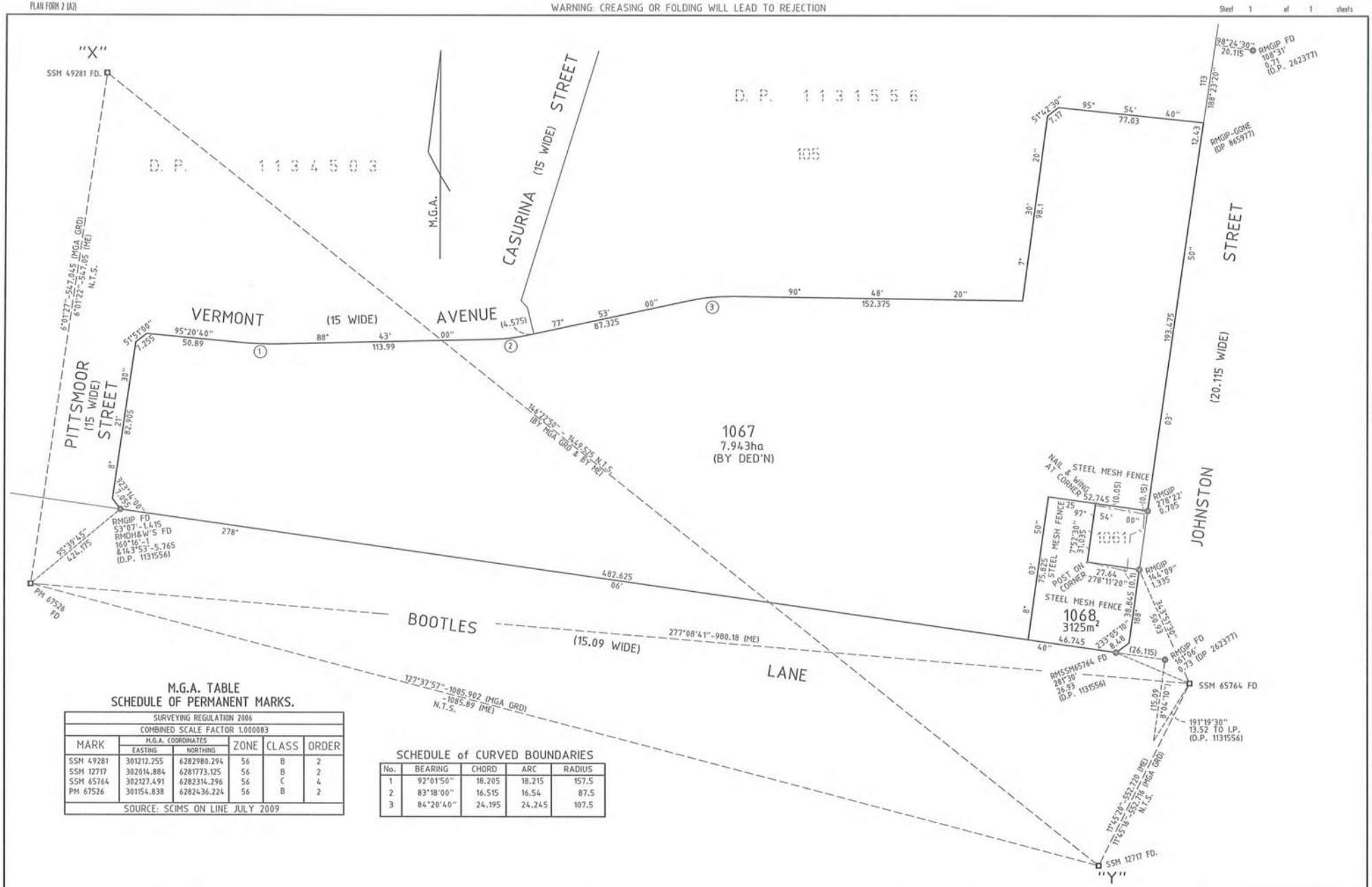
The development as described in the accompanying drawings and reports does not require an approval under either Part 3A or development consent under Part 4 of the EP & A Act. This review of the potential environmental impacts of this activity has been undertaken in accordance with the requirements of Part 5 of the *Environmental Planning and Assessment Act 1979.* **It is concluded that the proposed activity is unlikely to have a significant impact on the environment if the ameliorating measures indicated in this report are implemented**

Appendix 1	Plan of Lot 1062 Deposited Plan 1131838
Appendix 2	Ecology Assessment
Appendix 3	Acoustic Assessment
Appendix 4	Odour Assessment

SECTION K

Appendix 1 – Plan Lot 1062 DP 1131838

PLAN FORM 2 (A2) WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION Sheet 1 of 1 sheets



M.G.A. TABLE
SCHEDULE OF PERMANENT MARKS.

SURVEYING REGULATION 2006					
COMBINED SCALE FACTOR 1.000083					
MARK	M.G.A. COORDINATES		ZONE	CLASS	ORDER
	EASTING	NORTHING			
SSM 49281	301212.255	6282980.294	56	B	2
SSM 12717	302014.884	6281773.125	56	B	2
SSM 65764	302127.491	6282314.296	56	C	4
PM 67526	301154.838	6282436.224	56	B	2
SOURCE: SCIMS ON LINE JULY 2009					

SCHEDULE of CURVED BOUNDARIES

No.	BEARING	CHORD	ARC	RADIUS
1	92°01'50"	18.205	18.215	157.5
2	83°18'00"	16.515	16.54	87.5
3	84°20'40"	24.195	24.245	107.5

DRAFT ONLY!

Surveyor : ANTHONY MICHAEL ATKINS Date of Survey : 31 JULY 2009 Surveyor's Ref : 10-3454-WF	PLAN OF SUBDIVISION OF LOT 1062 IN D.P. 1131838	LGA: HAWKESBURY Locality : PITT TOWN Subdivision No: Lengths are in metres. Reduction Ratio 1:1250	Registered	DP

00 10 20 30 40 50 Table of mm 90 100 110 120 130 140

SECTION K

Appendix 2 – Ecology Assessment

Ecology Assessment for Recycled Water Factory at Bootles Lane, Pitt Town

April 2010

Water Factory Company Pty Ltd

Parsons Brinckerhoff Australia Pty Limited
ABN 80 078 004 798

Level 27, Ernst & Young Centre
680 George Street
SYDNEY NSW 2000
GPO Box 5394
SYDNEY NSW 2001
Australia
Telephone +61 2 9272 5100
Facsimile +61 2 9272 5101
Email sydney@pb.com.au

Certified to ISO 9001, ISO 14001, AS/NZS 4801

2117125 PR_5201

Revision	Details	Date	Amended By
00	Original	30 March 2010	
Final	Final	06 April 2010	

Author: ..... Paul Rossington

Signed: .....

Reviewer: ..... Martin Predavec

Signed: .....

Approved by: ..... Martin Predavec

Signed: .....

Date: ..... 06 April 2010

Distribution: Water Factory Company Pty Ltd, DBL Property, Johnson property Group, PB file

Please note that when viewed electronically this document may contain pages that have been intentionally left blank. These blank pages may occur because in consideration of the environment and for your convenience, this document has been set up so that it can be printed correctly in double-sided format.

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Glossary

Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: ▪ genetic diversity — the variety of genes (or units of heredity) in any population ▪ species diversity — the variety of species ▪ ecosystem diversity — the variety of communities or ecosystems.
Bioregion (region)	A bioregion defined in a national system of bioregionalisation. For this study this is the Sydney Basin bioregion bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
Critical Habitat	The whole or any part or parts of an area or areas of land comprising the habitat of an Endangered species, an Endangered population or an Endangered ecological community that is critical to the survival of the species, population or ecological community (Department of Environment and Conservation 2004). Critical habitat is listed under either the TSC Act and the EPBC Act and both the state (Department of Environment, Climate Change and Water) and Federal (Department of the Environment, Water, Heritage and the Arts) Directors-General maintain a register of this habitat. Capitalisation of the term 'Critical Habitat' in this report refers to the habitat listed specifically under the relevant state and Commonwealth legislation.
Department of Environment and Climate Change	The former name for the NSW Department of Environment, Climate Change and Water.
Department of Environment, Climate Change and Water	Broadly, the Department of Environment, Climate Change and Water works towards a healthy environment cared for and enjoyed by the whole NSW community; manages the state's natural resources, including biodiversity, soils and natural vegetation; manages natural and cultural heritage across the state's land and waters; acts to minimise the impacts of climate change; promotes sustainable consumption, resource use and waste management; regulates activities to protect the environment; and conducts biodiversity, plant, environmental and cultural heritage research to improve decision making.
Department of the Environment and Heritage	The former name for the Commonwealth Department of the Environment, Water, Heritage and the Arts.
Department of the Environment and Water Resources	The former name for the Commonwealth Department of the Environment, Water, Heritage and the Arts.
Department of the Environment, Water, Heritage and the Arts	The department develops and implements national policy, programs and legislation to protect and conserve Australia's natural environment and cultural heritage and administers the EPBC Act. The Commonwealth Department of the Environment, Water, Heritage and the Arts changed their name from the Department of the Environment and Water Resources in 2007, which was previously the Department of the Environment and Heritage.
Ecological community	An assemblage of species occupying a particular area.
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
FM Act	*Fisheries Management Act 1994*
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic components.

Key Threatening Processes	A process that threatens, or could threaten, the survival, abundance or evolutionary development of native species, populations or ecological communities (Department of Environment and Conservation 2004). Key threatening processes are listed under the TSC Act, the *Fisheries Management Act 1994* and the EPBC Act. Capitalisation of the term 'Key Threatening Processes' in this report refers to those processes listed specifically under the relevant state and Commonwealth legislation.
Likely	Taken to be a real chance or possibility (Department of Environment and Conservation 2004).
Local population	The population that occurs within the site, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated as defined by Department of Environment and Climate Change (2007).
Locality	The area within a 10 km of the site.
Migratory species	Species listed as Migratory under the EPBC Act. Capitalisation of the term 'Migratory' in this report refers to those species listed as Migratory under the EPBC Act.
Noxious weed	An introduced species listed under the *Noxious Weeds Act 1993.* Under the Act, noxious weeds have specific control measure and reporting requirements.
NSW	New South Wales
Protected species	Those species defined as protected under the *National Parks and Wildlife Act 1974*. Includes all native animals, as well as all native plants listed on Schedule 13 of the *National Parks and Wildlife Act 1974*.
Site	The location of the proposed Recycled Water factory and associated infrastructure
Study area	The site and a 20 m buffer around the site to encompass areas of potential indirect impacts
Recovery plan	A plan prepared under the TSC Act or the EPBC Act to assist the recovery of a Threatened species, population or ecological community.
Significant	Important, weighty or more than ordinary as defined by Department of Environment and Climate Change (2007).
Threatened biodiversity	Threatened species, populations or ecological communities as listed under either the TSC Act or the EPBC Act.
Threatened species, populations and ecological communities	Species, populations and ecological communities listed as Vulnerable, Endangered or Critically Endangered (collectively referred to as Threatened) under the TSC Act, *Fisheries Management Act 1994* or the EPBC Act. Capitalisation of the terms 'Threatened', 'Vulnerable', 'Endangered' or 'Critically Endangered' in this report refers to listing under the relevant state and/or Commonwealth legislation.
TSC Act	NSW *Threatened Species Conservation Act 1995*
Viable local population	A population that has the capacity to live, develop and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (Department of Environment and Climate Change 2007).

Executive summary

The proposed development includes the construction and operation of a recycled water factory and associated infrastructure including two large storage tanks, vehicle and pedestrian access and fencing at the corner of Bootles Lane and Johnston Street, Pitt Town.

Known and potential habitat for threatened species and ecological communities is located within the study site albeit in a degraded state. The vegetation of the site includes Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest which is listed as a Critically endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This same vegetation community is listed as Shale Gravel Transition Forest in the Sydney Basin Bioregion listed as an Endangered ecological community under the state *Threatened Species Conservation Act 1995* (TSC Act).

The Cumberland Land Snail which is listed as Endangered under the TSC Act and the Little Lorikeet which is listed as Vulnerable were recorded on the site. A variety of Threatened species of birds, mammals and plants listed under the TSC Act and EPBC Act also have potential to occur here.

The main impacts of the proposal are the removal of a small amount of a Threatened ecological community which is also habitat for Threatened species of plants and animals. The proposal would also require the removal of immature and semi-mature trees and dead standing trees from a previously disturbed area.

These impacts would be mitigated by measures that would:

- minimise construction impacts
- re-establish locally native plant species
- protect individuals of the Cumberland land Snail and its habitat
- replace tree hollows lost as a result of the project
- minimise weed invasion in retained native vegetation.

With the relatively small area of vegetation and habitat affected and the inclusion of these mitigation measures the project is unlikely to cause a significant negative impact on the biodiversity of the study area or broader locality.

1. Introduction

This report aims to provide ecological information about the study area as part of a review of environmental factors (REF). Specifically this report aims to:

- Provide a description of the vegetation communities and flora and fauna habitats within and adjacent to the study area.
- Determine the likelihood of occurrence of Threatened biodiversity listed under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection* and *Biodiversity Conservation Act 1999* (EPBC Act) occurring within the study area.
- Determine if any species, population or ecological community would be significantly affected by the project.
- Recommend measures to minimise impacts on flora and fauna.

1.1 Proposed development

The proposed development includes the construction and operation of a recycled water factory and associated infrastructure including two large storage tanks, vehicle and pedestrian access and fencing. The location of the project is located at the corner of Bootles Lane and Johnston Street, Pitt Town as shown in Figure 1.1. The preliminary site layout is shown in Figure 3.1.

Included within the development are a number of measures designed to mitigate the potential impacts of the proposal on biodiversity values.

1.1.1 Legislative framework

The project is being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* EP&A Act. As such, a Review of Environmental Factors (REF) is required for the development.

Under Part 5 of the EP&A Act (s.111 and s.112), all projects must include an assessment of Threatened biodiversity and their habitats that are likely to occur within the area of the development or that may be indirectly affected by the construction and operation of a project. If Threatened biodiversity or their habitats are found on site, an assessment of whether the project is '*likely to have a significant effect on the environment*' must be made, and a decision made on whether an Environmental Impact Statement (EIS) or Species Impact Statement (SIS) is required. In order to make this decision, a determining authority must consider the effect of an activity on:

- Critical habitat (listed under the TSC Act or *Fisheries Management Act 1994* (FM Act).
- In the case of Threatened species, populations and ecological communities, and their habitats (listed under the TSC Act or FM Act) whether there is likely to be a significant effect on those species, populations or ecological communities (as determined in Section 5A of the EP&A Act), or those habitats.
- Any other protected fauna or protected native plants within the meaning of the *National Parks and Wildlife Act 1974* (NPW Act).

Section 5A of the EP&A Act outlines the seven factors that must be taken into account when deciding whether a project is likely to have a significant impact on Threatened biodiversity or their habitats (significance assessments).

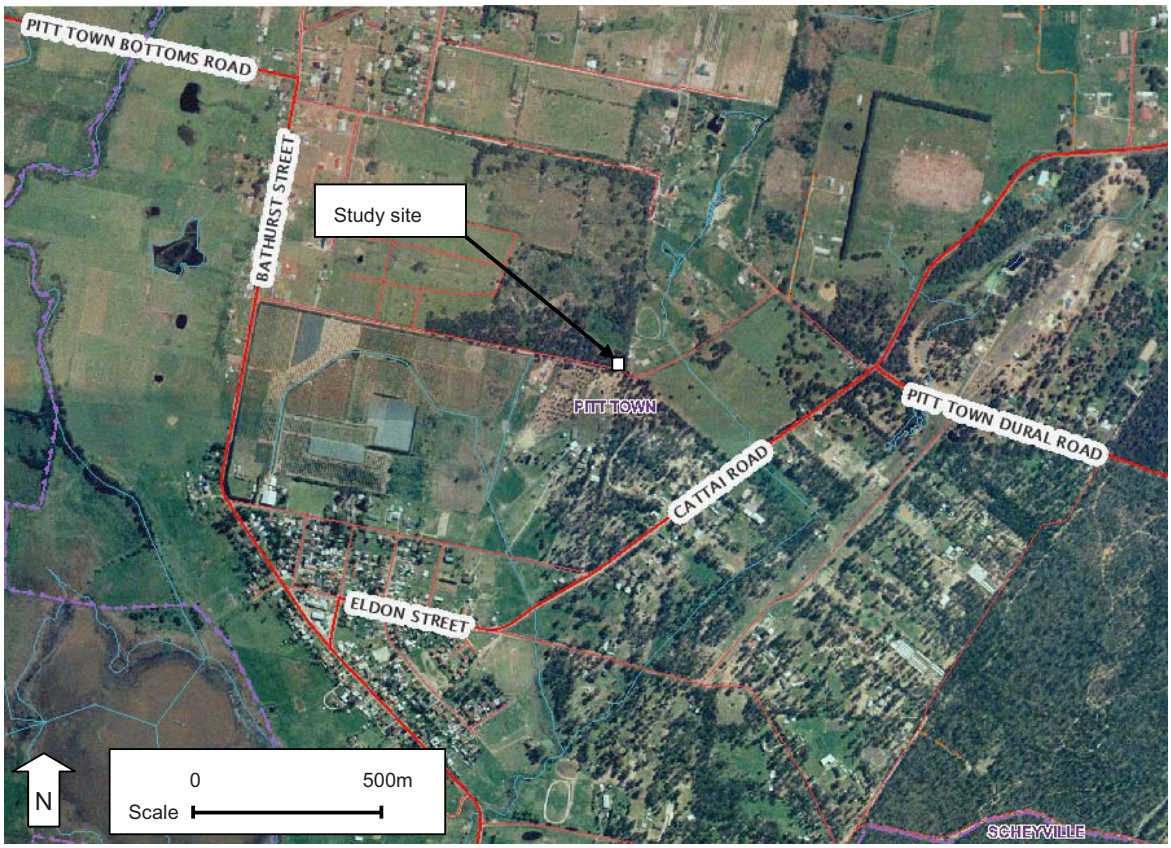


Figure 1.1 Study site location

2. Methods

This assessment is largely based on the earlier flora and fauna study conducted for the adjacent sewage pumping station (SPS) and sewer main (Maunsell AECOM 2008). The study area for the previous study encompassed the entire site of the current project. A site inspection and review of Threatened species records and changes to listings under the TSC Act and EPBC Act was used to update the findings of the previous study and relate these to the specific conditions of the site of the current project.

The ecology survey and assessment included desk-based searches of databases and historical records as well as field survey in the site. This section outlines the specific methods used to survey and assess biodiversity in the site. An assessment was also undertaken of the vegetation to the west of the site, and where relevant information on the adjacent site has been incorporated into this report.

2.1 Nomenclature

Names of plants used in this document follow Harden (1992; 1993; 2000; 2002) with updates from PlantNet (Royal Botanic Gardens 2010) and the Australian Plant Census (Council of Heads of Australasian Herbaria 2010). Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided in plant lists in Appendices A and B. Introduced species are identified within the text with an asterix following the name, for example *Lantana camara*[*].

Names of vegetation communities used in this report are based on the dominant species and structure of the community. Where practical, the names follow those used in Threatened community listings under the TSC Act, and/or the EPBC Act.

Names of vertebrates follow the Census of Australian Vertebrates (CAVS) database maintained by the Department of the Environment, Water, Heritage and the Arts (Department of the Environment Water Heritage and the Arts 2010a).

2.2 Subject site and study area

The site for the study includes the footprint of construction works and the area to be enclosed by site fencing. The subject site covers an area of approximately 0.3 ha north-west of the intersection of Bootles Lane and Johnson Street.

The study area considered in this report includes the subject site and an additional distance of twenty metres around the subject site to account for indirect impacts on adjacent areas.

2.3 Database searches and literature review

A review was undertaken of the previous flora and fauna impact assessment conducted for the adjacent pumping station site (Maunsell AECOM 2008).The Maunsell AECOM report considered a study area that encompasses the current subject site and forms the basis of the impact assessment conducted for the current proposal.

Database searches were undertaken for Threatened biodiversity within the vicinity of the site to capture additional species records and changes to legislative listings since the Maunsell AECOM report was prepared. Database searches are summarised in Table 2.1.

Table 2.1 Databases searched for records of Threatened biodiversity

Database search	Search date	Area searched	Reference
Atlas of NSW Wildlife	10 March 2010	10 km buffer around the central point of the subject site	(Department of Environment Climate Change and Water 2010a)
EPBC Protected Matters Search Tool	10 March 2010	10 km buffer around the central point of the subject site.	(Department of the Environment Water Heritage and the Arts 2010b)
Threatened species, populations and communities database	10 March 2010	Sydney Metropolitan Catchment Management Area, Cumberland subcatchment	(Department of Environment Climate Change and Water 2010b)

Note: Flora and fauna database searches were completed as a radius (10 km) around the centre of the subject site (33.580308S, 150.867827E).

2.4 Field survey

Field surveys for the current project were undertaken on 11 March 2010. The surveys assessed the extent and condition of vegetation communities and flora and fauna habitat. Survey effort and design was based on the Department of Environment and Climate Change Guidelines and species specific guidelines (e.g. for the Cumberland Land Snail (National Parks and Wildlife Service 2000).The survey covered the entire study area.

2.4.1 Vegetation survey

Vegetation mapping for the locality (NSW National Parks and Wildlife Service 2002) was reviewed to determine which vegetation communities have previously been mapped within and adjacent to the study site.

Vegetation mapping within the site was undertaken through visual identification of the edges of vegetation in each condition category (refer section 3.2) and marking this information on the survey plan for the site using the surveyed locations of trees and fences and roads as a reference.

Due to the small size of the site and fine scale variation in vegetation condition, the entire area of each vegetation condition type encountered was surveyed. Plant species and their abundances within each condition type were recorded.

2.4.2 Condition and quality assessment of vegetation communities

The condition of vegetation was assessed using parameters such as intactness, diversity, history of disturbance, weed invasion and health. Three categories were used to describe the condition of vegetation communities:

- **Good:** Vegetation still retains the species complement and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time and displays resilience to weed invasion due to intact groundcover, shrub and canopy layers.
- **Medium:** Vegetation generally still retains its structural integrity, but has been disturbed and has lost some component of its original species complement. Weed invasion can be significant in such remnants.

- **Poor:** Vegetation that has lost most of its species and is significantly modified structurally. Often such areas have a discontinuous canopy of the original tree cover, with very few shrubs. Exotic species, such as introduced pasture grasses or weeds, replace much of the indigenous ground cover. Environmental weeds are often co-dominant with the original indigenous species.

2.4.3 Quality of fauna habitats

The fauna assessment of the site was based primarily on the habitats present. Threatened species are often difficult to detect and a lack of Threatened species records cannot necessarily be used to argue for the absence of the species from the site when suitable habitat is present. Suitable habitat is, therefore, the most important factor to consider when determining the potential presence of Threatened species.

Fauna habitats were generally assessed by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation, the structure and composition of the litter layer, and other habitat attributes important for feeding, roosting and breeding. The following criteria were used to evaluate habitat values:

- **Good:** full range of fauna habitat components usually present (e.g. old-growth trees, fallen timber, feeding and roosting resources) and habitat links to other remnant ecosystems in the landscape are intact.
- **Moderate:** some fauna habitat components are missing (e.g. old-growth trees and fallen timber, native understorey or ground layer vegetation).
- **Poor:** many fauna habitat elements in low quality remnants have been lost, including old growth trees (e.g. due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented and understorey and ground layers dominated by introduced species of plant.

2.4.4 Species of animal

Fauna survey was limited to a search of potential Cumberland Land Snail habitat, a search for signs of other fauna (e.g. scats, tracks, scratches) and opportunistic recordings of bird species. Habitat assessments were used to determine suitable habitat for Threatened species.

Surveys for Cumberland Land Snail

The Cumberland Land Snail feeds on fungus and lives within the ground layer vegetation and leaf litter of woodlands and forests within the Cumberland Plain region. The species is often associated with rotting logs and other woody debris which provide shelter and a substrate for the fungus on which they feed.

Surveys were undertaken by lifting all fallen logs on the site and within a 20 m buffer and the examination of leaf litter accumulated around the bases of trees.

3. Existing environment

3.1 Site context

Pitt Town is located in the Hawkesbury local government area, approximately 60 km north west of Sydney Central Business District in a semi-rural area characterised by agricultural, horticultural and rural residential holdings.

The site covers approximately 0.3 ha and is located on partially cleared land at the edge of a patch of remnant woodland of approximately 8 ha.

The site is located approximately 1.2 km from a large remnant of forest and woodland within Scheyville National Park. Degraded woodland within nearby properties provides some connectivity between the national park and the habitat of the study site.

3.2 Vegetation

3.2.1 Description

The vegetation of the site is mapped as Shale Gravel Transition Forest(NSW National Parks and Wildlife Service 2002)The flora survey verified the presence of this vegetation community on the site with the relatively high abundance of *Eucalyptus teriticornis* and *Eucalyptus moluccana* and paucity of *Eucalyptus fibrosa* indicating that the community in this location is transitional with the Shale Plains Woodland (Tozer 2003) which is mapped further to the west.

Shale Gravel Transition Forest is listed as an endangered ecological community, as *Shale Gravel Transition Forest in the Sydney Basin Bioregion*, under the TSC Act.

Shale Gravel Transition Forest is considered to be a subset of the *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* Critically Endangered ecological community listed under the EPBC Act.

The TSC Act listing for *Shale Gravel Transition Forest* includes disturbed remnants where these are considered likely to respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact (Department of Environment and Climate Change 2005).

Condition thresholds for vegetation patches to meet the description of the *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* as listed under the EPBC Act are shown in Table 3.1. All four condition categories meet the definition of the listed community.

Table 3.1 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest Commonwealth listing condition thresholds

Category	Thresholds
Category A	Minimum patch size is ≥0.5ha
	AND
	≥50% of the perennial understorey vegetation cover is made up of native species
Category B	Minimum patch size is ≥0.5ha
	AND
	≥30% of the perennial understorey vegetation cover is made up of native species
Category C	The patch size is ≥0.5ha
	AND
	≥30% of the perennial understorey vegetation cover is made up of native species
	AND
	The patch is contiguous with a native vegetation remnant that is ≥5ha in area.
Category D	The patch size is ≥0.5ha
	AND
	≥30% of the perennial understorey vegetation cover is made up of native species
	AND
	The patch has at least one tree with hollows per hectare or at least one large tree (≥80cm diameter at breast height) per hectare from the upper tree layer

The community was found to occur in three distinct condition types as described in Tables 3.2, 3.3 and 3.4.

Figure 3.1 shows the distribution of these vegetation condition types and a full list of species recorded within each community is provided in Appendix E.

Table 3.2 Vegetation condition type 1

Condition Type 1 - Scattered trees and introduced groundcover

Location	Covering the 0.15 ha of the study area, this condition type occurs in the location of the northern tank. .
Description	Canopy: occasional immature *Eucalyptus mollucana* present. Little evidence of canopy regeneration. Groundcover: Dominated by introduced grasses (>70% cover) including *Pennisetum clandestinum**, *Setaria* spp*. A few native species occur here at low density e.g. *Commelina cyanea*.
Species diversity	13 species in total, 4 native (31%) native
Condition	Poor. This community was dominated by introduced species and had a low diversity of native species. Unlikely to contain a substantial native seedbank.
Threatened species of plant?	None recorded. This community does not provide suitable habitat for any Threatened species of plant.
Threatened community?	No. Not consistent with any listed community

Table 3.3 Vegetation condition type 2

Condition Type 2 - Native canopy and highly disturbed ground layer	
Location	Covering 0.17 ha of the study area this condition type occurs in the location of the Recycled Water Factory
Description	Canopy: mature and semi-mature mature *Eucalyptus moluccana* present. Little evidence of canopy recruitment. Understorey: absent Groundcover: Dominated by bare ground and introduced grasses (>70 % cover), low shrubs and herbs including *Pennisetum clandestinum**, *Setaria* spp*, *Sida rhombifolia*, Bidens subalternans** and *Asparagus aethiopicus**. A few small patches containing native species occur here at low density e.g. *Commelina cyanea* and *Eriochloa pseudoacrotrich*a.
Species diversity	15 species in total, 6 (40%) native
Condition	Poor. The understorey of this vegetation is absent and the ground layer is highly disturbed and dominated by introduced species. Unlikely to contain a substantial native seedbank.
Threatened species of plant?	None recorded. This community does not provide suitable habitat for any Threatened species of plant.
Threatened community?	No. Not consistent with any listed community

Table 3.4 Vegetation condition type 3

Condition Type 3 - Native canopy and moderately disturbed understorey and ground layer	
Location	Covering approximately 0.05 ha in the south-west of the site on the edge of a woodland remnant of approximately 8 ha and in similar condition.
Description	Canopy: mature and semi-mature mature trees present. Little evidence of canopy recruitment. Understorey: occasional native shrubs (*Bursaria spinosa* and *Indigofera australis*) and introduced species (*Sida rhombifolia*). Groundcover: A mixture of native and introduced grasses, and herbs including, native species (>50% cover; *Commelina cyanea, Einadia hastata, Microlaena stipoides, Eriochloa pseudoacrotricha*) and introduced species (*Setaria* spp**, Bidens subalternans** and *Asparagus aethiopicus*, Asparagus asparagoides**). Approximately 40-50% cover of native perennial understorey species. Contiguous with adjacent woodland patch.
Species diversity	21 species in total, 13 (62%) native
Condition	Moderate. The understorey of this vegetation is sparse and the ground layer is moderately disturbed and invaded by introduced species including noxious weeds.
Threatened species of plant?	None recorded. This community provides marginal potential habitat for several Threatened species of plant.
Threatened community?	Consistent with the TSC Act listing for Shale Gravel Transition Forest Consistent with the Condition Category D (refer table 3.1) Commonwealth listed Cumberland Plain Woodland and Shale Gravel Transition Forest community.

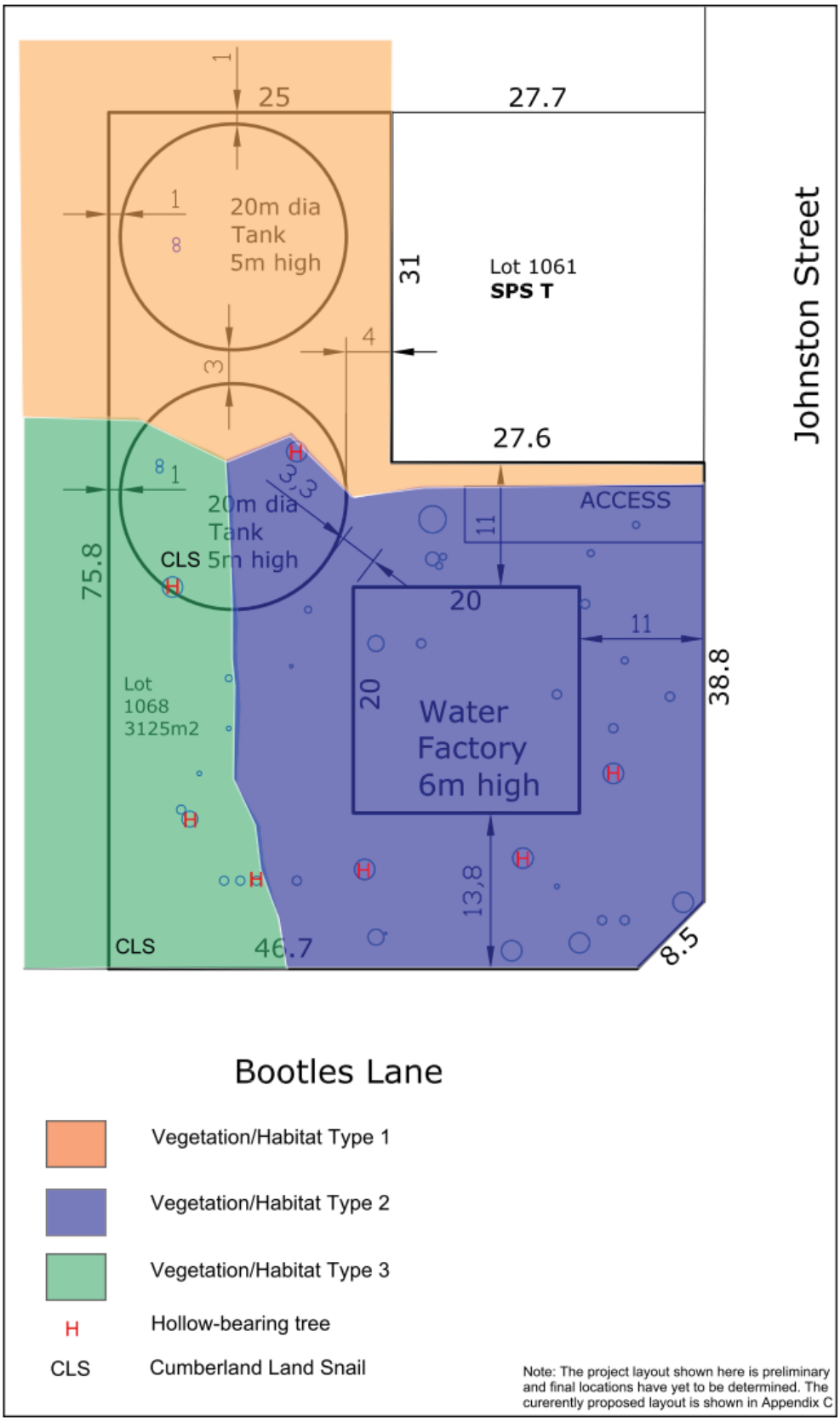


Figure 3.1 Vegetation and habitat condition types

3.2.2 Threatened species of plant

No Threatened species of plant was recorded within the site. The flora and fauna assessment report conducted for the existing pump station (Maunsell AECOM 2008) identified the following species as having a moderate likelihood of occurrence within the vegetation type occurring on the site:

- *Acacia pubescens*
- *Dillwynia tenuifolia*
- *Grevillea juniperina* subsp. *juniperina*
- *Pimelea spicata*
- *Pultenaea parviflora*
- *Persoonia nutans.*

Although none of these species were recorded on the site, the Condition Type 3 vegetation provides suitable habitat for these species. It is possible that one or more of these species may be present in the soil seedbank. The small area affected is considered unlikely to support an ecologically significant proportion of any such population that may be present.

3.2.3 Weeds

Two of the introduced plant species recorded within the site are listed as noxious species under the *Noxious Weeds Act 1993* within the Hawkesbury River County Council noxious weed control area (refer to Table 3.5).

Table 3.5 Noxious species of weed recorded within the site

Scientific name	**Common name**	**Noxious weed class[1]**	**Management requirements[1]**
Rubus fruticosus species complex	Blackberry	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Asparagus asparagoides	Bridal Creeper	5	The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with

[1] Defined by the *Noxious Weeds Act 1993*

3.3 Fauna habitat

3.3.1 Description

Fauna habitat types recorded in the site correspond with the vegetation condition types described in section 3.2. A description of habitat attributes is provided in Table 3.6.

Table 3.6 Fauna habitat type 1

Scattered trees and introduced groundcover

Location	Covering the 0.15 ha of the site, this community occurs in the location of the northern storage tank. .
Habitat attributes (including microhabitat elements)	Exotic ground layer vegetation Minimal leaf litter or fallen timber No understorey Occasional immature trees No tree hollows
Fauna associations	Native bird and reptile species associated with open environments and disturbed vegetation, generalist and introduced species e.g. Blue-tongued Lizard, Wille Wagtail, Red-browed Finch, Australian Magpie, Magpie Lark, Red-whiskered Bulbul. Unlikely to be important habitat for any threatened fauna species
Condition	Poor. This community does not contain any potentially important habitat (breeding, roosting or foraging habitat) for any Threatened species of animal.

Table 3.7 Fauna habitat type 2

Native canopy and highly disturbed ground layer

Location	Covering approximately 0.17 ha of the study area, this community occurs in the location of the Recycled Water Factory.
Habitat attributes (including microhabitat elements)	Canopy: trees provide nectar, pollen, seeds and insect prey. Air spaces within and surrounding canopy are foraging habitat for bat species. Small to medium-sized tree hollows are potential nesting and/or roosting habitat for hollow-dwelling bats, birds and small arboreal mammals. Understorey: absent – no suitable nesting habitat for small birds Groundcover: bare ground with minimal leaf litter and scattered grasses and forbs, few fallen logs
Fauna associations	A variety of canopy-feeding bird species including nectar and seed-eating parrots, small seed and insect-eating birds. Ground-dwelling animal species unlikely to occur here. Hunting habitat for owls and birds of prey.
Condition	Moderate. The understorey of this vegetation is absent and the ground layer is highly disturbed and dominated by introduced species however the canopy is intact and provides habitat for a variety of native animals.
Threatened species of animal?	This community provides suitable habitat for Threatened species of birds and bats.

Table 3.8 Fauna habitat type 3

Native canopy and moderately disturbed understorey and ground layer

Location	Covering approximately 0.05 ha in the south-west of the study area on the edge of a larger woodland remnant of approximately 8 ha
Habitat attributes (including microhabitat	Canopy: trees provide nectar, pollen, seeds and insect prey. Air spaces within and surrounding canopy are foraging habitat for bat species. Small to medium-sized tree hollows are potential nesting and/or roosting habitat for hollow-dwelling bats, birds and small arboreal mammals.

Native canopy and moderately disturbed understorey and ground layer	
elements)	Understorey: sparse – minimal suitable nesting habitat for small birds, some foraging habitat Groundcover: mixture of native and introduced grasses and forbs, fallen logs, leaf litter
Fauna associations	A variety of canopy-feeding bird species including nectar and seed-eating parrots, small seed and insect-eating birds. Foraging and shelter habitat for round-dwelling animal species present. Hunting habitat for owls and birds of prey.
Condition	Moderate. The understorey of this vegetation is sparse and invaded by weeds and the ground layer is moderately disturbed however the canopy is intact and provides habitat for a variety of native animals. The edge location of this habitat may limit its suitability for some species.
Threatened species of animal?	The Cumberland Land Snail was recorded here. This community also provides suitable habitat for Threatened species of birds and bats.

3.3.2 Threatened species habitat

Two Threatened species of animal were recorded within the site during field surveys, Cumberland Land Snail and Little Lorikeet.

A small flock of Little Lorikeets was observed flying over the study area. The Cumberland Land Snail was observed in two locations within the study area, one of which would be affected by the proposed works. These locations are within 30 m of one another and are considered to be part of a single population.

Review of the Maunsell AECOM report and recent database searches revealed that the habitat types recorded on the site provide potential habitat for a further 24 Threatened species listed under the TSC Act including:

- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Circus assimilis* (Spotted Harrier)
- *Climacteris picumnus* (Brown Treecreeper)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Hieraaetus morphnoides* (Little Eagle)
- *Lathamus discolor* (Swift Parrot)
- *Lophoictinia isura* (Square-tailed Kite)
- *Melithreptus gularis gularis* (Black-chinned Honeyeater eastern subspecies)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Mormopterus norfolkensis* (Eastern Freetail-bat)
- *Ninox connivens* (Barking Owl)
- *Ninox strenua* (Powerful Owl)
- *Petaurus australis* (Yellow-bellied Glider)
- *Petroica boodang* (Scarlet Robin)

- *Petroica phoenicea* (Flame Robin)
- *Phascolarctos cinereus* (Koala)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Pyrrholaemus sagittatus* (Speckled Warbler)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Tyto novaehollandiae* (Masked Owl)
- *Xanthomyza phrygia* (Regent Honeyeater).

Of these the following three species are also listed under the EPBC Act:

- *Lathamus discolor* (Swift Parrot)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Xanthomyza phrygia* (Regent Honeyeater).

3.3.3 Migratory species

Migratory species are protected under the international agreements to which Australia are a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered Matters of National Environmental Significance and are protected under the EPBC Act.

Eight migratory species of bird are considered to have potential to occur in on the site (Maunsell AECOM 2008). These include:

- *Hirundapus caudacutus* (White-throated Needletail)
- *Merops ornatus* (Rainbow Bee-eater)
- *Monarcha melanopsis* (Black-faced Monarch)
- *Myiagra cyanoleuca* (Satin Flycatcher)
- *Rhipidura rufifrons* (Rufous Fantail)
- *Xanthomyza phrygia* (Regent Honeyeater)
- *Ardea ibis* (Cattle Egret)
- *Apus pacificus* (Fork-tailed Swift).

Under the EPBC Act, an action is likely to have a significant impact on a Migratory species if it substantially modifies, destroys or isolates an area of important habitat for the species (Department of the Environment and Heritage 2006). For all species of Migratory bird considered likely to occur, the site is not considered to compromise important habitat as it does not contain:

- Habitat used by a Migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species.
- Habitat that is of critical importance to the species at particular life-cycle stages.
- Habitat used by a Migratory species that is at the limit of the species' range.
- Habitat within an area where the species is declining

3.3.4 Pest species

Three species of feral animal were observed in the site including the Common Mynah, Red-whiskered Bulbul and European Rabbit.

Common Mynah and Red-whiskered Bulbul were commonly observed on the site while the rabbit was detected through scat identification.

These exotic species have the potential to exert pressure on native species of animal either directly (predation/aggression) or indirectly (competition for resources).

4. Potential impacts

Impacts of the proposal include:

- Loss of approximately 0.02 ha of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest / Shale Gravel Transition Forest and associated known and potential habitat for Threatened species of plants and animals.
- Loss of 13 live immature to semi-mature trees (*Eucalyptus moluccana*) and 1 dead standing tree from areas of highly disturbed vegetation.
- Loss of two hollow-bearing trees containing approximately six hollows with openings ranging from approximately 5 cm to 10 cm in diameter.
- Possible damage to the root systems of retained trees including three hollow-bearing trees in close proximity to the proposed Recycled Water Factory structure.

The proposal will thereby contribute to the following key threatening process listed under the TSC Act:

- Loss of Hollow-bearing Trees
- Removal of dead wood and dead trees
- Clearing of native vegetation.

Formal impact assessments under NSW and Commonwealth legislation are found in Appendix A and Appendix B.

For the purposes of these assessment, Threatened species have been grouped according to their habitat usage patterns and hence their susceptibility to the potential impacts of the proposal.

The grouping of species is summarised in Table 4.1

The impact significance assessment concluded that no significant impact on any Threatened species, population or ecological community or listed Migratory species is likely to occur as a result of the project.

Table 4.1 Threatened species grouping for impact assessment

Group name	Description	Species
Understorey shrubs	Shrub species susceptible to impacts such as removal of understory and weed invasion	*Acacia pubescens* *Dillwynia tenuifolia* *Grevillea juniperina subsp. juniperina* *Pimelea spicata* *Pultenaea parviflora* *Persoonia nutans*
Cumberland Land Snail	Considered separately due to its distinct habitat requirements	Cumberland Land Snail

Group name	Description	Species
Microbats	Most species reliant on tree hollows for roosting and/or breeding. Aerial foragers which are less sensitive to impacts on understorey.	Large-eared Pied Bat Eastern Freetail-bat Eastern Bent wing-bat (not hollow-dependent) Eastern False Pipistrelle Greater Broad-nosed Bat
Small foliage-nesting birds	Birds that nest and forage in the understorey or canopy and are not reliant on tree hollows	Scarlet Robin Flame Robin Varied Sitella Speckled Warbler Black-chinned Honeyeater
Migratory nectar-feeding birds	Species which migrate into the area during the flowering times of local trees and are unlikely to breed in the locality	Swift Parrot Regent Honeyeater
Small to medium-sized hollow-dependent birds and arboreal mammals	Small yet highly mobile species which are hollow-dependent and capable of utilising hollows with a relatively small entrance diameter	Brown Treecreeper Little Lorikeet Yellow-bellied Glider Gang Gang Cockatoo
Large mobile birds and mammals	Large highly mobile animals with large home ranges. NB: includes owl species reliant on very large trees hollows which are not found on site	Powerful Owl Masked Owl Barking Owl Spotted Harrier Little Eagle Koala Square-tailed Kite

5. Proposed biodiversity impact mitigation

The proposal also includes the following measures to mitigate the impacts identified in Section 4:

- Temporary fencing will be installed to minimise potential damage to retained trees during construction.
- Earthworks and soil disturbance around retained trees will be minimised in order to avoid root damage.
- A pre-clearance survey will be conducted for the Cumberland Land Snail involving the collection of snails and woody debris from the earthworks area, by or under the direction of an ecologist, and relocation of these to the adjacent woodland prior to the onset of construction activities.
- A buffer between the site and the adjacent woodland patch will be created and maintained to limit edge effects and weed invasion through fencing and weed control within a 4 m wide strip of modified woodland within the site boundaries.
- Landscaping of the remaining non-operational areas and boundaries of the site will be conducted with plant species which are native to the Threatened community and compatible with the operation of the site.
- Installation of six nest boxes on live trees will be conducted within and immediately adjacent to the site prior to the onset of construction activities. Nest box installation would be supervised by an ecologist and would include designs suitable for use by hollow-dependent microbats, small parrots and large parrots/medium-sized arboreal mammals. Two boxes of each type would be installed.
- Monitoring of retained hollow-bearing trees for a period of three years will be conducted. If retained hollow-bearing trees die during this time, three nest boxes will be installed for each tree that dies as described above.
- Augmentation of the habitat of the adjacent woodland will be conducted through the placement of large woody debris on the edges and within open areas under the direction of an ecologist.
- Woody weeds and introduced grasses will be removed from a 300m^2 area of highly disturbed adjacent to the woodland patch located to the west of the site, and mulching and replacement planting of this area will be conducted with plant species which are native to the Threatened community.
- Strategic placement of hardstand pedestrian access and landscape plantings adjacent to the existing sewerage pumping station site will be conducted to prevent the spread of *Pennisetum clandestinum* (Kikuyu Grass).

6. Summary

Known and potential habitat for threatened species and ecological communities is located within the study site albeit in a degraded state. This includes known occurrences and habitat for:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest- listed as an Endangered ecological community under the EPBC Act.
- Shale Gravel Transition Forest in the Sydney Basin Bioregion- listed as an Endangered ecological community under the TSC Act.
- Cumberland Land Snail which is listed as endangered under the TSC Act.
- A variety of Threatened species of birds and mammals listed under the TSC Act and EPBC Act (refer Section 3.2.2).
- A variety of Threatened species of plants listed under the TSC Act and EPBC Act (refer Section 3.3.2).

The main impacts of the proposal are:

- Removal of a small amount (approximately 0.03 ha) of a Threatened ecological community which is also habitat for Threatened species of plants and animals.
- Removal of 13 immature and semi-mature trees and two dead standing trees.
- Removal of two hollow-bearing trees.

These impacts would be mitigated as described in detailed in section 5. These measures aim to:

- Minimise construction impacts.
- Re-establish of locally native plant species.
- Protect individuals of the Cumberland land Snail and its habitat.
- Minimise weed invasion in retained native vegetation.

With the inclusion of these mitigation measures the proposal is unlikely to cause a significant negative impact on the biodiversity of the study area or broader locality.

7. References

Council of Heads of Australasian Herbaria 2010, *Australian Plant Census*, Australian National Botanic Gardens, 22/01/10,

Department of Environment and Climate Change 2005, *Threatened species profile for the endangered ecological community, Shale Gravel Transition Forest.*, <.

Department of Environment and Climate Change 2007, *Threatened species assessment guidelines. The assessment of significance*, Department of Environment and Climate Change, Hurstville.

Department of Environment and Conservation 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)*, Department of Environment and Conservation, Hurstville.

Department of Environment Climate Change and Water 2010a, *Atlas of NSW Wildlife*, database.

Department of Environment Climate Change and Water 2010b, *Threatened species, populations and ecological communities of NSW database*, <.

Department of the Environment and Heritage 2006, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*, Department of the Environment and Heritage, Canberra.

Department of the Environment Water Heritage and the Arts 2010a, *Census of Australian Vertebrates (CAVS) database,* , Department of the Environment Water Heritage and the Arts, Canberra,

Department of the Environment Water Heritage and the Arts 2010b, *Protected Matters Search Tool*, Department of the Environment, Water, Heritage and the Arts, < >.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2 (Revised Edition)*, 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

Maunsell AECOM 2008, 'Proposed Pump Station and Rising Main Flora and Fauna Report'.

National Parks and Wildlife Service 2000, *Cumberland Plain Land Snail (Meridolum corneovirens Pfeiffer, 1851) Environmental Impact Assessment Guidelines*, National Parks and Wildlife Service,, Hurstville.

NSW National Parks and Wildlife Service 2002, *Final Native Vegetation Mapping of the Cumberland Plain, Western Sydney*, NSW National Parks and Wildlife Service, Hurstville.

Royal Botanic Gardens 2010, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <.

Thackway, R & Cresswell, ID 1995, *An Interim Biogeographic Regionalisation of Australia*, Australian Nature Conservation Agency, Canberra.

Tozer, M 2003, 'The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities', *Cunninghamia*, vol. 8, no. 1, pp. 1-75.

Appendix A

Impact assessment for TSC Act listed biodiversity

Threatened Species

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Understorey shrubs**	**Cumberland Land Snail**	**Microbats**	**Small foliage-nesting birds**	**Migratory nectar-feeding birds**	**Small to medium-sized hollow-dependent birds and arboreal mammals**	**Large mobile birds and mammals**
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Unlikely to significantly affect pollination, seed dispersal or recruitment due to the very small proportion of local habitat affected and low impact on potential pollen and seed vectors	Unlikely to significantly affect breeding. Some disturbance to some potential breeding habitat however the extent of habitat affected is a small proportion of habitat in the immediate surrounding the site and individuals and important habitat components will be relocated. Woody debris as a result of tree removal will be used to augment adjacent habitat.	Unlikely to significantly affect breeding. Some potential breeding habitat affected (tree hollows) however the extent of habitat affected is a small proportion of habitat in the immediate surroundings of the site and installation of nest boxes (including bat boxes) will be conducted	Unlikely to significantly affect breeding habitat. Small amount of edge-affected understorey vegetation (nesting habitat) to be removed and abundance of more suitable habitat within adjacent vegetation	Unlikely to affect breeding habitat. Species seasonal/occasional visitors and highly unlikely to breed on the site.	Unlikely to significantly affect breeding. Some loss of potential breeding habitat (tree hollows) however the extent of habitat affected is a small proportion of habitat in the immediate surroundings of the site and installation of nest boxes will be conducted	Unlikely to significantly affect breeding. Tree hollows affected are not of sufficient entrance diameter to support breeding by large owls. Other species do not have specialised breeding habitat requirements.

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Understorey shrubs**	**Cumberland Land Snail**	**Microbats**	**Small foliage-nesting birds**	**Migratory nectar-feeding birds**	**Small to medium-sized hollow-dependent birds and arboreal mammals**	**Large mobile birds and mammals**
In relation to the habitat of a threatened species, population or ecological community: *(a) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*	Approximately 0.03 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	Approximately 0.03 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.	Approximately 0.03 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.	Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.	Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.
b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Understorey shrubs**	**Cumberland Land Snail**	**Microbats**	**Small foliage-nesting birds**	**Migratory nectar-feeding birds**	**Small to medium-sized hollow-dependent birds and arboreal mammals**	**Large mobile birds and mammals**
c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of any local populations of these species.	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of the local population of the species.	The hollows trees affected contribute to the long-term viability of local populations of these species however hollow trees are also found in adjacent woodland and nest boxes provide an alternative to the hollows lost.	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of local populations of these species.	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of the local populations of the species.	The hollows trees affected contribute to the long-term viability of local populations of these species however hollow trees are also found in adjacent woodland and nest boxes provide an alternative to the hollows lost.	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of any local populations of these species
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat listed for any of these species.	No critical habitat listed for any of these species.	No critical habitat listed for any of these species.	No critical habitat listed for any of these species.	No critical habitat listed for any of these species in NSW.	No critical habitat listed for any of these species.	No critical habitat listed for any of these species.

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Understorey shrubs**	**Cumberland Land Snail**	**Microbats**	**Small foliage-nesting birds**	**Migratory nectar-feeding birds**	**Small to medium-sized hollow-dependent birds and arboreal mammals**	**Large mobile birds and mammals**
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There are no threat abatement plans of relevance to these species in the context of the proposal. Recovery plans have been approved for: Persoonia nutans and Acacia pubescens Most of the recovery actions are designed to be undertaken by government agencies and research bodies and are of limited relevance to the proposal. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species.	There are no threat abatement plans of relevance to these species in the context of the proposal. No recovery plan has been approved for this species.	There are no threat abatement plans of relevance to these species in the context of the proposal. No recovery plan has been approved for any of these species.	There are no threat abatement plans of relevance to these species in the context of the proposal. No recovery plan has been approved for any of these species.	There are no threat abatement plans of relevance to these species in the context of the proposal. No NSW recovery plan has been approved for any of these species.	There are no threat abatement plans of relevance to these species in the context of the proposal. A recovery plan has been approved for the Yellow-bellied Glider. Most of the recovery actions are designed to be undertaken by government agencies and research bodies and are of limited relevance to the proposal. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for this species.	There are no threat abatement plans of relevance to these species in the context of the proposal Recovery plans have been approved for: *Large Forest Owls* including the Powerful owl and Masked Owl. Most of the recovery actions are designed to be undertaken by government agencies and research bodies and are of limited relevance to the proposal. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species.

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Understorey shrubs**	**Cumberland Land Snail**	**Microbats**	**Small foliage-nesting birds**	**Migratory nectar-feeding birds**	**Small to medium-sized hollow-dependent birds and arboreal mammals**	**Large mobile birds and mammals**
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process	The proposal will contribute to the *Clearing of native vegetation* key threatening process (KTP) which is of relevance to these species. The extent of clearing is however very small and revegetation with native species will be conducted.	The proposal will contribute to the *Clearing of native vegetation* and *Removal of dead wood and dead trees* KTPs which are of relevance to this species. The extent of clearing and wood removal is however very small and revegetation with native species and relocation of woody debris will be conducted.	The proposal will contribute to the *Clearing of native vegetation* and *Loss of Hollow-bearing Trees* KTPs which are of relevance to these species. The extent of clearing very small and revegetation with native species will be conducted. Although two hollow-bearing trees will be removed, bat boxes will be installed to mitigate this loss.	The proposal will contribute to the *Clearing of native vegetation* key threatening process (KTP) which is of relevance to these species. The extent of clearing is however very small and revegetation with native species will be conducted.	The proposal will contribute to the *Clearing of native vegetation* key threatening process (KTP) which is of relevance to these species. The extent of clearing is however very small and revegetation with native species will be conducted.	The proposal will contribute to the *Clearing of native vegetation* and *Loss of Hollow-bearing Trees* KTPs which are of relevance to these species. The extent of clearing very small and revegetation with native species will be conducted. Although two hollow-bearing trees will be removed, nest boxes will be installed to mitigate this loss.	The proposal will contribute to the *Clearing of native vegetation* key threatening process (KTP) which is of relevance to these species. The extent of clearing is however very small and revegetation with native species will be conducted.

NB: criteria relating exclusively to Threatened ecological communities and Threatened populations are not relevant and have been omitted.

Threatened Ecological Communities

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Shale Gravel Transition Forest**
In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: *(a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*	Approximately 0.03 ha of the community would be removed which is a small proportion (approximately 0.4%) of extent of the community in the immediate area surrounding the site. This extent of removal is considered unlikely to substantially increase the risk of extinction of the local occurrence of the community.
(b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	The proposal is likely to modify the condition of the community through small scale changes to light and water availability associated with edge effects. The proposed inclusion of a buffer area in which weed species would be managed would however mitigate this impact. The retained vegetation is unlikely to be substantially and adversely modified that its local occurrence is likely to be placed at risk of extinction.
In relation to the habitat of a threatened species, population or ecological community: *(a) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*	Approximately 0.03 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.
b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation

Assessment of Significance Criteria (under section 5A of the EP&A Act)	**Shale Gravel Transition Forest**
c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,	The habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of the local occurrence of this ecological community.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat listed for this ecological community
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	Most of the recovery actions for this community are designed to be undertaken by government agencies and research bodies and are of limited relevance to the proposal. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process	The proposal will contribute to the *Clearing of native vegetation* key threatening process (KTP) which is of relevance to this ecological community. The extent of clearing is however very small and revegetation with native species will be conducted.

Appendix B

Commonwealth impact significance assessments

Endangered Species

Under the EPBC Act, an action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will result in one or more of the following significant impact criteria considered below.

Significant impact criteria	**Understorey shrubs** Pimelea spicata	**Migratory nectar-feeding birds** Swift Parrot and Regent Honeyeater
lead to a long-term decrease in the size of a population	Species not recorded in the study area or nearby woodland patches. Given the small size and moderately to highly disturbed condition of the area of habitat affected, the site is unlikely to contain an ecologically significant proportion of any population of the species that may be present in the soil seedbank.	Unlikely to significantly affect population sizes of these highly mobile species as the extent of habitat affected is a small proportion of habitat in the immediate surroundings of the site and large areas of similar habitat are also found in the nearby Scheyville National Park.
reduce the area of occupancy of the species	Species not recorded in the study area or nearby woodland patches. Approximately 0.02 ha of potential habitat is to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging. These species are likely to use this modified habitat and the area of occupancy of these species is unlikely to be affected.
fragment an existing population into two or more populations	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation for these highly mobile species.
adversely affect habitat critical to the survival of a species	No critical habitat has been listed for this species. The potential habitat affected is disturbed due to edge effects and weed invasion and is unlikely to be important to the long-term survival of any local populations of these species.	No critical habitat has been listed for these species under the EPBC Act. The habitat affected is of marginal quality as foraging habitat and considered likely to be used on an occasional or sporadic basis.
disrupt the breeding cycle of a population	Proposal is unlikely to disrupt the breeding of any population of this species that may be present as it is unlikely to impact processes such as pollination, seed dispersal and seedling recruitment.	Neither of these species is likely to breed in the study area or broader locality. The Swift Parrot is only known to breed in Tasmania and the Regent Honeyeater regularly breeds in only a few locations in eastern Australia. The proposal is unlikely to disrupt the breeding cycle of a population of either these species.

Significant impact criteria	**Understorey shrubs**	**Migratory nectar-feeding birds**
	Pimelea spicata	Swift Parrot and Regent Honeyeater
modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Species not recorded in the study area or nearby woodland patches. Given the small size and moderately to highly disturbed condition of the area of habitat affected, the project is unlikely to affect potential habitat for the species to such an extent that the species would be at increased risk of decline.	The potential habitat affected is disturbed due to edge effects, weed invasion and partial clearing and is unlikely to be important to the long-term survival of these species in the locality.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal is unlikely to result in the establishment of additional weed species or other invasive species. The project is unlikely to increase the impact of existing weed infestations due to the weed management and revegetation measures proposed.	The proposal is unlikely to result in the establishment of additional weed species or other invasive species. The project is unlikely to increase the impact of existing weed infestations due to the weed management and revegetation measures proposed.
introduce disease that may cause the species to decline	The proposal is unlikely to introduce plant diseases as equipment would be clear of excess soil prior entry to the site.	The proposal is unlikely to introduce bird diseases as translocation of birds material that has been in contact with birds is not proposed.
interfere with the recovery of the species	Habitat loss and modification as a result of the project is of a very small extent and is unlikely to interfere with the recovery of the species.	Habitat loss and modification as a result of the project is of a very small extent and is unlikely to interfere with the recovery of these species.

Vulnerable Species

Under the EPBC Act, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following factors considered below.

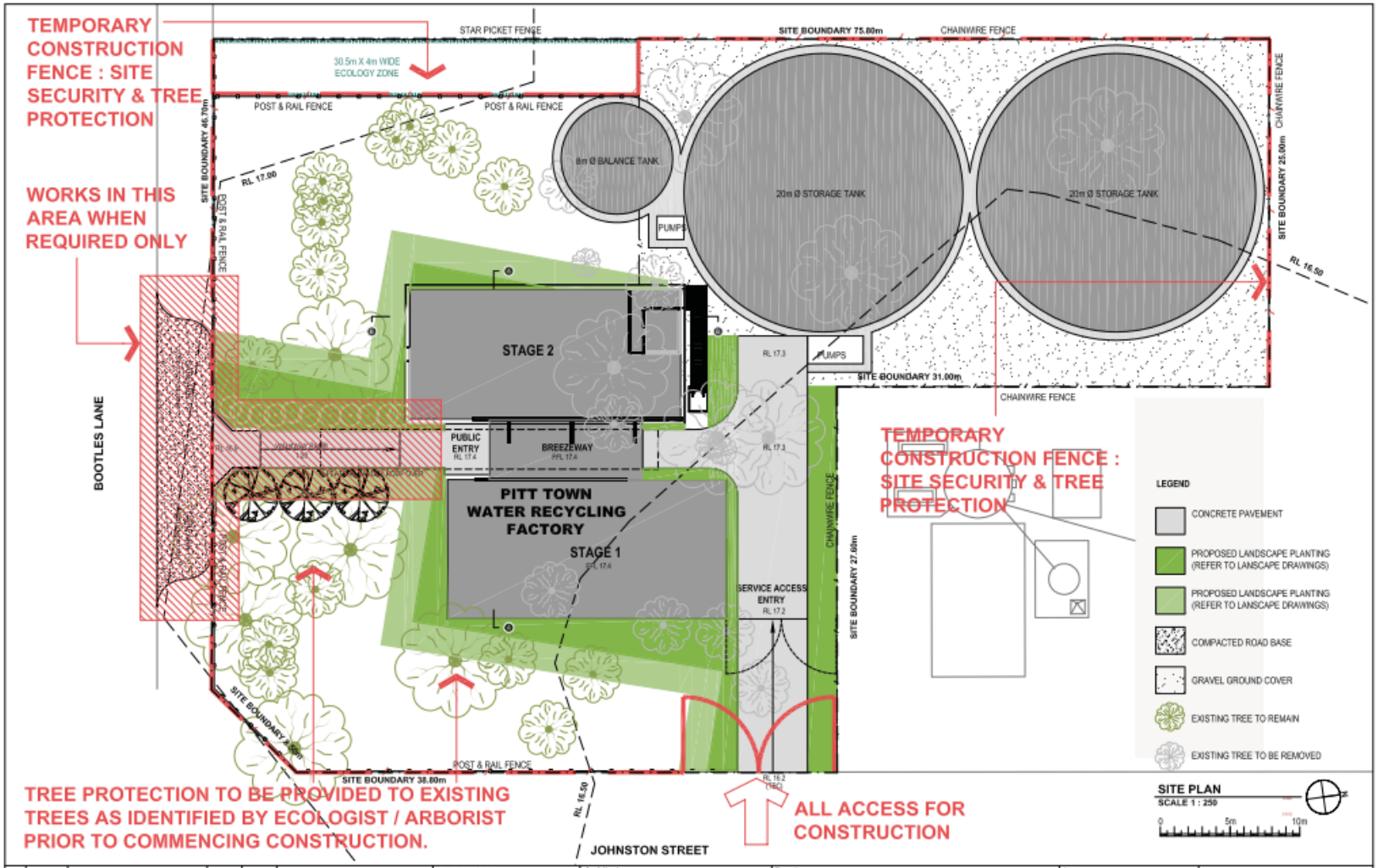
Assessment of Significance Criteria	Understorey shrubs	Microbats	Large mobile birds and mammals
lead to a long-term decrease in the size of an important population of a species	No important population of any of these species is considered likely to occupy the study area. Approximately 0.02 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	No important population of any of these species is considered likely to occupy the study area. Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.	No important population of any of these species is considered likely to occupy the study area. Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.
reduce the area of occupancy of an important population	No important population of any of these species is considered likely to occupy the study area. Approximately 0.02 ha of habitat to be removed which is a small proportion (approximately 0.4%) of available habitat in the immediate area surrounding the site.	No important population of any of these species is considered likely to occupy the study area. Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging and roosting.	No important population of any of these species is considered likely to occupy the study area. Approximately 0.2 ha of habitat to be removed or modified which is a small proportion (approximately 3%) of available habitat in the immediate area surrounding the site. Modified habitat likely to remain suitable for foraging.

Assessment of Significance Criteria	Understorey shrubs	Microbats	Large mobile birds and mammals
fragment an existing important population into two or more populations	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation for these highly mobile species.	Proposal is at the edge of existing habitat and is unlikely to have any discernable impact on fragmentation for these highly mobile species.
adversely affect habitat critical to the survival of a species	No critical habitat listed for any of these species. The habitat on the site is not considered to be critical to the survival of these species.	No critical habitat listed for any of these species. The habitat on the site is not considered to be critical to the survival of these species.	No critical habitat listed for any of these species. The habitat on the site is not considered to be critical to the survival of these species.
disrupt the breeding cycle of an important population	Unlikely to significantly affect pollination, seed dispersal or recruitment due to the very small proportion of local habitat affected and low impact on potential pollen and seed vectors.	Unlikely to significantly affect breeding. Some potential breeding habitat affected (tree hollows) however the extent of habitat affected is a small proportion of habitat in the immediate surroundings of the site and installation of nest boxes (including bat boxes) will be conducted	Unlikely to significantly affect breeding. Tree hollows affected are not of sufficient entrance diameter to support breeding by large owls. Other species do not have specialised breeding habitat requirements.
result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat	The proposal is unlikely to result in the establishment of additional weed species or other invasive species. The project is unlikely to increase the impact of existing weed infestations due to the weed management and revegetation measures proposed.	The proposal is unlikely to result in the establishment of additional weed species or other invasive species. The project is unlikely to increase the impact of existing weed infestations due to the weed management and revegetation measures proposed.	The proposal is unlikely to result in the establishment of additional weed species or other invasive species. The project is unlikely to increase the impact of existing weed infestations due to the weed management and revegetation measures proposed.

Assessment of Significance Criteria	Understorey shrubs	Microbats	Large mobile birds and mammals
interfere substantially with the recovery of the species	The project is unlikely to substantially affect the habitat of these species. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species. The project is unlikely to interfere substantially with the recovery of the species	The project is unlikely to substantially affect the habitat of these species. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species. The project is unlikely to interfere substantially with the recovery of the species	The project is unlikely to substantially affect the habitat of these species. The mitigation measures which form part of the action are considered to be consistent with the recovery objectives for these species. The project is unlikely to interfere substantially with the recovery of the species

Appendix C

Indicative site layout



Rev	Date	Amendment	Initials	Check
A	23/03/10	ISSUE FOR CLIENT REVIEW	VC	--
B	29/03/10	ISSUE FOR CLIENT REVIEW	VC	--

GENERAL NOTES

Morrison Design Partnership Pty. Limited accept no responsibility for the usability, completeness or accuracy of data transferred electronically.
Recipients should where necessary request a hard copy version for verification.
This drawing shall be read in conjunction with all architectural and other consultants drawings and specifications and with such other written instructions as may be issued during the course of the contract.
Figured dimensions shall be taken in preference to scaling.
Level, setout points and dimensions on this drawing shall be verified by the builder on site.
All discrepancies shall be referred to the architect for direction before proceeding with any works.

SURVEY NOTES

Survey data included in this drawing is based on "Weber Buchan Pty Ltd" (registered surveyor), survey ref. 89363S, dated 18th November 2008 and is provided for preliminary design purposes only.
As this drawing is based on information supplied by others, reference must be made to original survey drawings verified against site conditions.

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Architects
Morrison Design Partnership
ARCHITECTS
ACN : 081 900 208
Nominated Architect
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 5303
Email morrisondesign@ozemail.com.au
GLEN OLLERTON AIA Reg No. 7921

Drawing: SITE PLAN-TEMPORARY CONSTRUCTION FENCE

Project: PITT TOWN WATER FACTORY

Scale:	1 : 200 @ A3
Drawn:	VC
Checked:	GO
Date:	MARCH 2010
Project Principal:	G. OLLERTON
Project Number:	2632
Drawing Number:	SK06
Revision:	B

North:

Appendix D

Threatened Species likelihood of occurrence assessments

Threatened Plants

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
Fabaceae (Mimosoideae)	*Acacia bynoeana* (Bynoe's Wattle)	E1	V	3V	Yes	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (Harden 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri* (NSW National Parks and Wildlife Service 1999a).	Low
Fabaceae (Mimosoideae)	*Acacia gordonii*	E1	E	2K	Yes	Occurs in the lower Blue Mountains from Bilpin to Faulconbridge and also in the Glenorie district. Grows on sandstone outcrops and amongst rock platforms in dry sclerophyll forest and heath (Harden 2002; NSW Scientific Committee 1997). Specifically this species occurs in Sydney Sandstone Ridgetop Communities (James 1997b).	Low
Fabaceae (Mimosoideae)	*Acacia pubescens* (Downy Wattle)	V	V	3Va	Yes Not recorded within site however is found nearby	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically, it occurs at the intergrade between shales and sandstones in gravely soils often with ironstones (Harden 2002; NSW National Parks and Wildlife Service 2003a).	Moderate
Casuarinaceae	*Allocasuarina glareicola*	E1	E		Yes	Restricted to the Sydney basin where it occurs north east of Penrith in or near Castlereagh State Forest. Grows on lateritic soil in open forest (Harden 2000).	Low
Celastraceae	*Apatophyllum constablei*	E1	E	2E	No	Occurs in dry sclerophyll forest on slopes with a north to north-westerly aspect. It typically grows near cliffs (i.e. near the base or just above). The soils at sites are sandy and skeletal, mostly on Narrabeen sandstone. Found in association with *Eucalyptus piperita*, *E. punctata*, *E. sparsifolia*, *Banksia serrata*, *Acacia linifolia*, *Cleistochloa rigida*, *Lomandra obliqua* (Department of Environment and Climate Change 2005)	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
Orchidaceae	*Caladenia tessellata* (Thick Lip Spider Orchid)	E1	V	3V	No	Occurs south of Swansea where it grows on clay loam or sandy soils (Harden 1993). Prefers low open forest with a heathy or sometimes grassy understorey (Bishop 2000). Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas (NSW Scientific Committee 2002a).	Low
Myrtaceae	*Callistemon linearifolius* (Netted Bottle Brush)	V		2Ri	No	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies (Fairley, A. & Moore 2002; Harden 2002; Robinson 1994). Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (NSW Scientific Committee 1999a).	Low
Hygrophoraceae	*Camarophyllopsis kearneyi*	E1			No	A small, pale, gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove Local Government Area in Sydney (NSW National Parks and Wildlife Service 2002a).	Low
Euphorbiaceae	*Chamaesyce psammogeton* (Sand Spurge)	E1			No	Occurs in coastal regions of NSW where it grows on sand dunes near the sea (Harden 2000). Grows on fore-dunes and exposed headlands, often with Spinifex (*Spinifex sericeus*) (Department of Environment and Conservation 2005c).	Low
Asclepiadaceae	*Cynanchum elegans* (White-flowered Wax Plant)	E1	E	3Ei	No	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes (Harden 1992). This species typically occurs at the ecotone between dry subtropical forest/woodland communities (James 1997b; NSW National Parks and Wildlife Service 2002b).	Low
Myrtaceae	*Darwinia biflora*	V	V	2Va	Yes	Occurs from Cheltenham to Hawkesbury River where it grows in heath on sandstone or in the understorey of woodland on shale-capped ridges (Harden 2002). Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include Eucalyptus haemastoma, Corymbia gummifera and/or E. squamosa. The vegetation	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						structure is usually woodland, open forest or scrub-heath (Department of Environment and Climate Change 2008).	
Myrtaceae	*Darwinia peduncularis*	V		3Ri	No	Occurs from Hornsby to Hawkesbury River and west to Glen Davies where it grows in dry sclerophyll forest on sandstone hillsides and ridges (Harden 2002). Known to occur along watercourses (Benson 2001). Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone (Department of Environment and Climate Change 2007).	Low
Poaceae	*Deyeuxia appressa*	E1	E	2E	No	Occurs in the Hornsby area on wet ground. (Harden 1993; Sharp & Simon 2002).	Low
Fabaceae (Faboideae)	*Dillwynia tenuifolia*	V	V	2Vi	Yes Not recorded during survey	Occurs on the Cumberland Plain from the Blue Mountains to Howes Valley area where it grows in dry sclerophyll woodland on sandstone, shale or laterite (Harden 2002). Specifically, occurs within Castlereagh woodlands, particularly in shale gravel transition forest. Associated species include *Eucalyptus fibrosa*, *E. sclerophylla*, *Melaleuca decora, Daviesia ulicifolia, Dillwynia juniperina* and *Allocasuarina littoralis* (James 1997b).	Moderate
Orchidaceae	*Diuris aequalis* (Buttercup Doubletail)	E1	V	3V	No	Occurs chiefly in the ranges and tablelands from Braidwood to Kanangra and Liverpool where it grows among grass in sclerophyll forest (Harden 1993). It typically occurs on gentle slopes, in gravely clay-loam soil within montane eucalypt forest with a grass or heath understorey (Bishop 2000). Three small populations are known to occur within Kanangra Boyd National Park, other populations are restricted to remnant vegetation within roadsides and agricultural lands (NSW Scientific Committee 2002c).	Low
Ericaceae (Styphelioideae)	*Epacris purpurascens* var. *purpurascens*	V		2K	Yes	Occurs in Gosford and Sydney districts where it grows in sclerophyll forest, scrub and swamps (Harden 1992). Usually found in sites with a strong shale influence (NSW National Parks and Wildlife Service 2002c).	Low
Myrtaceae	*Eucalyptus benthamii* (Nepean River Gum)	V	V	2Vi	No	*Eucalyptus benthamii* occurs only in wet open forest on sandy alluvial soils along valley floors at an elevation of 140-750m. Restricted to	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						Wallacia and Camden areas, Nepean River and Kedumba Creek, and Reedy and Cedar creeks in the central Blue Mountains (NSW National Parks and Wildlife Service 2000d).	
Myrtaceae	*Eucalyptus camfieldii* (Heart-leaved Stringybark)	V	V	2Vi	No	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park (Department of Environment and Climate Change). Occurs within poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges (Department of Environment and Climate Change).	Low
Myrtaceae	*Eucalyptus scoparia*	E1	V	2Vi	No	Occurs in Queensland and reaches its southern limit in NSW near Tenterfield. In NSW it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland (Royal Botanic Gardens 2004).	Low Local specimens planted.
Myrtaceae	*Eucalyptus* sp. Cattai	E1			Yes	Occurs in the area between Colo Heights and Castle Hill, historic records include the Royal Botanic Gardens, Sydney. It grows as an emergent tree in scrub, heath and low woodland on sandy soils, generally on flat ridge tops. It usually occurs as isolated individuals or occasionally in small clustered groups (Harden 2002).	Low
Rubiaceae	*Galium australe* (Tangled Bedstraw)	E1			No	Previously presumed extinct in NSW, this species is now known from a number of sites in coastal regions. In NSW, this species has been recorded in moist gullies of tall forest, *Eucalyptus tereticornis* forest, coastal Banksia shrubland, and *Allocasuarina nana* heathland. In other States the species is found in a range of near-coastal habitats, including sand dunes, sand spits, shrubland and woodland (Department of Environment and Conservation 2005c; Royal Botanic Gardens 2005).	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
Orchidaceae	*Genoplesium baueri*	V		3R	No	Grows in sparse sclerophyll forest and moss gardens over sandstone; from the Hunter Valley to Nowra district (Royal Botanic Gardens 2004).	Low
Grammitaceae	*Grammitis stenophylla* (Narrow-leaf Finger Fern)	E1			No	A fern which occurs in coastal regions from Queensland to the NSW south coast where it grows on rocks in rainforest and in wet sclerophyll forest (Harden 2000).	Low
Proteaceae	*Grevillea juniperina* subsp. *juniperina*	V			Yes	Restricted to the western Cumberland Plain, Marsden Park, Rooty Hill, Riverstone, Plumpton, Castlereagh NR, Blacktown, Penrith and north to Pitt Town, where it grows in open dry sclerophyll (eucalypt-dominated) forest or woodland in sandy to clay-loam soils and red pseudolateritic or sandy gravels (Fairley, Alan 2004; Royal Botanic Gardens 2005).	Moderate
Proteaceae	*Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)	V	V		No	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998a).	Low
Proteaceae	*Grevillea parviflora* subsp. *supplicans*	E1			Yes	Has a very restricted known distribution (approximately 8 by 10 km) and is confined to the north-west of Sydney near Arcadia and the Maroota Marramarra Creek area. It grows in heathy woodland on skeletal sandy soil over sandstone (NSW Scientific Committee 2000a).	Low
Haloragaceae	*Haloragis exalata* subsp. *exalata*	V*	V	3Va	No	Found in the south coast, central coast and north west slopes botanical regions where it appears to require protected and shaded damp situations in riparian habitats (Department of Environment and Climate Change 2008; Harden 2002).	Low
Haloragaceae	*Haloragodendron lucasii*	E1	E	2Ea	No	Confined to the Sydney area where it grows in dry sclerophyll open forest on sheltered slopes near creeks on sandstone (Harden 2002). Reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels (Department of Environment and	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						Conservation 2005c).	
Dilleniaceae	*Hibbertia superans*	E1			Yes	Occurs from Castle Hill to South Maroota where it grows in ridgetop woodlands usually near Shale/Sandstone Transition Forest. It is often associated with other Threatened flora including *Pimelea curviflora* var. *curviflora*, *Darwinia biflora*, *Epacris purpurascens* var. *purpurascens*, *Leucopogon fletcheri* subsp. *fletcheri*, *Acacia bynoeana*, *Eucalyptus* sp. Cattai and *Persoonia hirsuta* (NSW Scientific Committee 2001)	Low
Hygrophoraceae	*Hygrocybe anomala* var. *ianthinomarginata*	V			No	A small, brightly-coloured gilled fungus found in Lane Cove Bushland Park in the Lane Cove Local Government Area in Sydney, and from the Royal and Blue Mountains National Parks (NSW National Parks and Wildlife Service 2002d).	Low
Hygrophoraceae	*Hygrocybe aurantipes*	V			No	Small, brightly-coloured gilled fungus known only from its type locality in the Lane Cove Bushland Park in the Lane Cove Local Government Area in Sydney and from the Blue Mountains National Park (Mt Wilson) and Hazelbrook (NSW National Parks and Wildlife Service 2002e).	Low
Hygrophoraceae	*Hygrocybe austropratensis*	E1			No	Small, brightly-coloured gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove Local Government Area in Sydney (NSW National Parks and Wildlife Service 2002f).	Low
Hygrophoraceae	*Hygrocybe collucera*	E1			No	Small, brightly-coloured red gilled fungus and is known only from its type locality in the Lane Cove Bushland Park in the Lane Cove local government area in Sydney (NSW National Parks and Wildlife Service 2002g).	Low
Hygrophoraceae	*Hygrocybe griseoramosa*	E1			No	Small, buff to brown gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove local government area in Sydney (NSW National Parks and Wildlife Service 2002h).	Low
Hygrophoraceae	*Hygrocybe lanecovensis*	E1			No	Small, brightly-coloured gilled fungus known only from its type locality in Lane Cove Bushland Park in the Lane Cove Local Government Area in Sydney (NSW National Parks and Wildlife Service 2002i).	Low
Hygrophoraceae	*Hygrocybe reesiae*	V			No	Small, lilac coloured gilled fungus known in New South Wales only from its type locality in the Lane Cove Bushland Park in the Lane Cove Local	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						Government Area in Sydney, and from the Blue Mountains National Park (Hazelbrook Area). It is also found in Tasmania (NSW National Parks and Wildlife Service 2002j).	
Hygrophoraceae	*Hygrocybe rubronivea*	V			No	Small, brightly-coloured gilled fungus known only from its type locality in the Lane Cove Bushland Park in the Lane Cove local government area in Sydney (NSW National Parks and Wildlife Service 2002k).	Low
Sterculiaceae	*Lasiopetalum joyceae*	V	V	2R	No	Occurs on lateritic to shaley ridgetops of the Hornsby Plateau where it grows in heath and open woodland in sandy soils on sandstone (Fairley, A. & Moore 2002; Harden 2000; NSW Scientific Committee 1999b).	Low
Brassicaceae	*Lepidium hyssopifolium*	E1	E	3Ei	No	In NSW, there is a population consisting of 6 plants near Bathurst, a population near Bungendore and Crookwell both on the Southern Tablelands. The species was also recorded near Armidale in 1945 and 1958. The species occurs in a variety of habitats including woodland with a grassy understorey and grassland (Department of Environment and Conservation 2005c).	Low
Ericaceae (Styphelioideae)	*Leucopogon exolasius* (Woronora Beard-heath)	V	V	2V	No	Restricted chiefly to the Woronora and Grose Rivers and Stokes Creek, Sydney catchments and the Royal National Park. One old record from the Grose River. Grows in woodland on sandstone (Royal Botanic Gardens 2004).	Low
Ericaceae (Styphelioideae)	*Leucopogon fletcheri* subsp. *fletcheri*	E1		2R	Yes	Grows in dry Eucalypt woodland or in shrubland on clay, lateritic soils or Hawkesbury sandstone (Fairley, Alan 2004). Found on sandstone ridges and upper slopes in heath or woodland, sometimes in or below sandstone-shale ecotone; often associated with lateritic soils with some clay influence (James 1997a; James *et al*. 1999).	Low
Juncaginaceae	*Maundia triglochinoides*	V			No	Occurs north from Sydney. Grows in swamps, creeks or shallow freshwater 30 to 60 cm deep on heavy clay, low nutrients. Associated with wetland species such as *Triglochin procerum* (Harden 1993).	Low
Myrtaceae	*Melaleuca biconvexa* (Biconvex Paperbark)	V	V		No	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie.	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						The main concentration of records is in the Gosford/Wyong area (NSW Scientific Committee 1998b). Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects (Department of Environment and Climate Change 2008; Harden 2002).	
Myrtaceae	*Melaleuca deanei*	V	V	3R	No	Occurs in coastal districts, including western Sydney (e.g. Baulkham Hills, Liverpool shires) from Berowra to Nowra where it grows in wet heath on sandstone and shallow/skeletal soils near streams or perched swamps (Harden 2002; James 1997b).	Low
Myrtaceae	*Micromyrtus minutiflora*	E1	V	2V	Yes	Occurs in the western part of the Cumberland Plain between Richmond and Penrith where it grows on Tertiary sediments in dry sclerophyll forest (Harden 2002; NSW Scientific Committee 2002b).	Low
Polygonaceae	*Persicaria elatior* (Tall Knotweed)	V	V	3V	No	Occurs infrequently in coastal regions where it grows in damp places especially beside streams and lakes. Also occasionally occurs in swamp forest or associated with disturbance (Department of Environment and Conservation 2005c; Harden 2000).	Low
Proteaceae	*Persoonia bargoensis*	E1	V	2V	No	Grows in woodland to dry sclerophyll forest, on sandstone and laterite. Restricted to the Bargo area (Harden 2002).	Low
Proteaceae	*Persoonia glaucescens* (Mittagong Geebung)	E1	V	2V	No	Occurs from Picton to Berrima where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) ridge-tops, plateaux and upper slopes. Prefers the interface between Lucas Heights and the Hawkesbury and Gymea Soil Landscapes. Commonly associated canopy species are *Corymbia gummifera*, *Eucalyptus sieberi* and *E. sclerophylla* as well as *E. pauciflora* (NSW National Parks and Wildlife Service 2000a).	Low
Proteaceae	*Persoonia hirsuta*	E1	E	3Ki	Yes	Occurs in central coast and central tableland districts where it grows in woodland to dry sclerophyll forest on sandstone (Harden 2002) and rarely shale (NSW Scientific Committee 1998c). Often occurs in areas with clay influence, in the ecotone between shale and sandstone (James 1997b).	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
Proteaceae	*Persoonia mollis* subsp. *maxima*	E1	E	2E	No	Restricted to the Hornsby Heights, Mt Colah area north of Sydney. It occurs on sheltered upper hillsides of narrow gullies of Hawkesbury sandstone characterised his by steep sideslopes, rocky benches and broken scarps, with creeks fed by small streams and intermittent drainage depressions. It grows in moist, tall forest (*Angophora costata, Eucalyptus piperita, Corymbia gummifera*), often with warm temperate rainforest influences (*Syncarpia glomulifera, Ceratopetalum apetalum, Callicoma serratifolia*). Sometimes recorded in low densities on the dry upper-hillsides of gullies and in more exposed aspects in association with *E. haemastoma* and *E. punctata* (NSW National Parks and Wildlife Service 2000b).	Low
Proteaceae	*Persoonia nutans* (Nodding Geebung)	E1	E	2Ei	Yes	Confined to the Cumberland Plain where it grows in Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands (Harden 2002; James 1997b; NSW National Parks and Wildlife Service 2001c).	Low
Marsileaceae	*Pilularia novae-hollandiae* (Austral Pillwort)	E1			No	Grows in seasonally dry depressions and margins of marshes and may grow submerged (Harden 2000). It grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud, as this is when it is most conspicuous (Department of Environment and Climate Change 2008).	Low
Thymelaeaceae	*Pimelea curviflora* var. *curviflora*	V	V		No	Confined to coastal areas around Sydney where it grows on sandstone and laterite soils. It is found between South Maroota, Cowan, Narrabeen, Allambie Heights, Northmead and Kellyville. Usually occurs in woodland in the transition between shale and sandstone, often on the Lucas Heights soil landscape (Harden 2000; James 1997b; James *et al.* 1999; NSW Scientific Committee 1998d).	Low
Thymelaeaceae	*Pimelea spicata*	E1	E	3Ei	Yes Not recorded during survey	This species occurs in two disjunct areas: in coastal districts from Lansdowne to Shellharbour and in Cumberland Plain Woodland inland to Penrith. In western Sydney, it grows on Wianamatta Shales in Greybox - Ironbark Woodland with Bursaria spinosa and Themeda australis. In the Illawarra, it occurs on well structured clay soils in grassland or open woodland (Harden 2000; James 1997b; NSW	Moderate

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						National Parks and Wildlife Service 2000c).	
Rhamnaceae	*Pomaderris brunnea*	V	V	2V	No	Confined to the Colo and Upper Nepean Rivers where it grows in open forest (Harden 2000); in western Sydney (Camden to Picton area) known from sandy alluvium on levee and creek banks (James 1997b).	Low
Orchidaceae	*Pterostylis saxicola* (Sydney Plains Greenhood)	E1	E		No	Known now only from Freemans Reach to Picton district. Grows in Sydney Sandstone Gully Forest in shallow or skeletal soils over sandstone shelves, often near streams (Department of Environment and Climate Change 2007; Harden 1993; James 1997b)	Low
Fabaceae (Faboideae)	*Pultenaea parviflora*	E1	V	2E	Yes Not recorded during survey	Restricted to the Cumberland Plain where it grows in dry sclerophyll forest on Wianamatta shale, laterite or alluvium (Harden 2002). Locally abundant within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. Also occurs in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (James 1997b; NSW National Parks and Wildlife Service 2002l).	Low
Fabaceae (Faboideae)	*Pultenaea pedunculata*	E1			No	Restricted to Wianamatta Shales of the Cumberland Plain from Bankstown to Liverpool and on the South Coast in the Southeast Corner Bioregion at Bournda. It grows on a variety of soils in dry sclerophyll forest and disturbed sites (Harden 2000; NSW National Parks and Wildlife Service 2002m; NSW Scientific Committee 1999c). It is largely confined to loamy soils in dry gullies in populations in the Windellama area (Department of Environment and Climate Change 2008).	Moderate
Sterculiaceae	*Rulingia prostrata*	E1	E	2Ei	No	Occurs south of Picton lakes where it mainly grows in gullies along the escarpment, south from Picton Lakes (Harden 2000), on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rowes Lagoon and one plant at Tallong) and on the North Coast. It occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue leaved Stringybark (*E. agglomerata*) Open Forest at Tallong; and in Brittle Gum (*E. mannifera*)	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
						Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemastoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest at Tomago (Department of Environment and Climate Change 2007).	
Myrtaceae	*Syzygium paniculatum* (Magenta Lilly Pilly)	E1	V	3Ri	No	Occurs between Buladelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002). On the south coast, the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast, Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (Department of Environment and Climate Change 2008).	Local specimens likely planted.
Elaeocarpaceae	*Tetratheca glandulosa*	V	V**	2V	Yes	Occurs from Mangrove Mountain to the Blue Mountains where it grows in sandy or rocky heath or scrub (Harden 1992). Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Vegetation communities correspond broadly to Benson & Howell's Sydney Sandstone Ridgetop Woodland (Map Unit 10ar) (Department of Environment and Climate Change 2008).	Low
Orchidaceae	*Thelymitra* sp. Kangaloon (Kangaloon Sun Orchid)		Z		No	Only known only from three locations near Robertson in the Southern Highlands. The species has an estimated extent of occurrence of 300 kml. The Kangaloon Sun-orchid has an estimated area of occupancy of 10 kml. The three localities are Butler's Swamp, Stockyard Swamp, and Wildes Meadow Swamp, all located above what is known as the Kangaloon Aquifer (Threatened Species Scientific Committee 2008)	Low
Convolvulaceae	*Wilsonia backhousei* (Narrow-leafed Wilsonia)	V			No	Occurs chiefly in the Sydney district but also common at Jervis Bay (Harden 2000). A salt tolerant species, it is found in intertidal saltmarshes and sometimes on seacliffs (NSW Scientific Committee 2000c).	Low

Family	Species Name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Recorded in the locality[4]	Preferred Habitat	Likelihood of occurrence[5]
Rutaceae	*Zieria involucrata*	E1	V	2Va	Yes	Occurs in the Blue Mountains where it grows in wet sclerophyll forest (Harden 2002). Occurs primarily on Hawkesbury sandstone. Also occurs on Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest, although some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Eucalyptus agglomerata* (Blue-leaved Stringybark) and *Allocasuarina torulosa* (Forest Oak) (Department of Environment and Climate Change 2008).	Low

Threatened Animals

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
Amphibians					
Giant Burrowing Frog (*Heleioporus australiacus*)	V	V	Yes	Around the Sydney area there is a marked preference for sandstone ridgetop habitat and broader upland valleys. In these locations, the frog is associated with small headwater creeklines and along slow flowing to intermittent creeklines. The vegetation is typically woodland, open woodland and heath and may be associated with 'hanging swamp' seepage lines and where small pools form from the collected water. They have also been observed occupying artificial ponded structures such as fire dams, gravel 'borrows', detention basins and box drains that have naturalised over time and are still surrounded by other undisturbed habitat. Do not appear to inhabit areas that have been cleared for agriculture or for urban development. Breed in summer and autumn in burrows in the banks of small creeks. Often spends significant periods of time underground during unfavourable conditions and to avoid detection during the day. (Cogger 2000; NSW National Parks and Wildlife Service 2001a).	Low
Green and Golden Bell Frog (*Litoria aurea*)	E1	V	Yes	Has a fragmented distribution of mainly near coastal locations from Lakes Entrance (Victoria) to south of the NSW-Queensland border; as far west as Bathurst in the more elevated southern tablelands and central slopes of NSW. Various types of habitat use have been documented. For breeding utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral locations that are more often dry than wet. Is found in various small pockets of habitat in otherwise developed areas and has the tendency of often turning up in highly disturbed sites. Lotic situations such as fast flowing streams appear to be one of the few water bodies not utilised, at least for breeding purposes. Habitat attributes associated with the various waterbodies occupied by the GGBF, and that appear to make such habitat more likely to be occupied, include that the water body is shallow, still or slow flowing, ephemeral and/or widely fluctuating, unpolluted and without heavy shading. Permanent waterbodies are also known to be used and there is historical evidence of occupation of large, often deep and permanent bodies of water. There is a clear preference shown by GGBF for sites with a complexity of vegetation structure (Department of Environment and Conservation 2004, 2005b).	Low
Heath Frog (*Litoria littlejohni*)	V	V	Yes	Distributed along the eastern slopes of the Great Dividing Range from the Watagan State Forest near Wyong, south to Buchan in Victoria. Appears restricted to sandstone woodland and heath communities at mid to high altitude. Forages in the tree canopy and the ground, and has been	Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				observed sheltering under rocks on high exposed ridges in summer. It is not known from coastal habitats (NSW Scientific Committee 2000b).	
Southern Bell Frog (*Litoria raniformis*)	E1	V	No	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. Breeding occurs during the warmer months and is triggered by flooding or a rise in water level. The species has been known to breed from early spring through to late summer/early autumn (Sept to April). During the breeding season, animals are found floating amongst aquatic vegetation (especially Reeds) within or at the edge of slow-moving streams, marshes, lagoons, lakes, farm dams and rice crops. Outside the breeding season animals disperse away from the water and take shelter beneath ground debris such as fallen timber and bark, rocks, grass clumps and in deep soil cracks. Prey includes a variety of invertebrates as well as other small frogs, including young of their own species (Department of Environment and Climate Change 2007).	Low
Giant Barred Frog (*Mixophyes iteratus*)	E1	E	No	A terrestrial species which occurs in rainforests, Antarctic beech or wet sclerophyll forest. Feeds on insects and smaller frogs (Cogger 2000). The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas (NSW Scientific Committee 1999d). More prevalent at lower altitudes and in larger streams than its congeners, although has been recorded in areas up to 1000 metres asl. (NSW National Parks and Wildlife Service 1999h).	Low
Red-crowned Toadlet (*Pseudophryne australis*)	V		Yes	Occurs within 160 km of Sydney where it is restricted to Hawkesbury Sandstone geology. Breeds in deep grass and debris adjacent to ephemeral drainage lines. When not breeding, individuals are found scattered around sandstone ridges under rocks and logs (Cogger 2000).	Low
Fish					
Macquarie Perch (*Macquaria australasica*)		E	No	The natural range of Macquarie Perch included the upper and middle reaches of the Murray-Darling basin as well as the Shoalhaven and Hawkesbury Rivers. However, this species has recently been sighted in only a few localities within these river systems. Preferred habitat includes deep water holes covered with rocks. Spawning occurs above shallow running water (Department of Primary Industries 2006)	Low
Australian Grayling (*Prototroctes maraena*)		V	No	It is a mid-water, freshwater species that occurs most commonly in clear, gravelly streams with a moderate flow. Prefers deep, slow flowing pools (NSW Fisheries 2004).	Low
Invertebrates					Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
Cumberland Plain Land Snail (*Meridolum corneovirens*)	E1		Yes Recorded during survey	Restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney and also along the fringes of River Flat Forest, especially where it meets Cumberland Plain Woodland. It is typically found under logs and other debris, amongst leaf litter and bark around bases of trees. It is also sometimes found under grass clumps and where possible it will burrow into loose soil (NSW National Parks and Wildlife Service 1999c).	Known to occur
Birds					
Spotted Harrier (*Circus assimilis*)	V		Yes	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. The Spotted Harrier occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (*e.g.* chenopods) (Marchant and Higgins 1993; Aumann 2001a). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. (DECCW 2010).	Moderate
Fork-tailed Swift (*Apus pacificus*)		M	Yes	Breeds from central Siberia eastwards through Asia, and is migratory, wintering south to Australia. Individuals never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks (Higgins 1999).	Low
Great Egret (*Ardea alba*)		M	Yes Not recorded during study	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets (Australian Museum 2003).	Low
Cattle Egret (*Ardea ibis*)		M	Yes Not recorded during study	The Cattle Egret is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005).	Low
Australasian Bittern (*Botaurus poiciloptilus*)	V		Yes	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory. (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002n).	Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
Bush Stone-curlew (*Burhinus grallarius*)	E1		Yes Not recorded during study	Requires sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well structured litter layer and fallen timber debris. Feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (NSW National Parks and Wildlife Service 1999b, 2003c).	Low
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	V		Yes	Occurs in wetter forests and woodland from sea level to an altitude over 2000 metres, timbered foothills and valleys, coastal scrubs, farmlands and suburban gardens (Pizzey & Knight 2007).	Low
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V		Yes	Occurs in eucalypt woodland and forest with *Casuarina*/*Allocasuarina* spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key *Allocasuarina* species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 1999d).	Low
Brown Treecreeper (eastern subsp) (*Climacteris picumnus victoriae*)	V		Yes	Found in eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts. Nesting occurs in tree hollows (Department of Environment and Conservation 2005a).	Low
Varied Sittella (*Daphoenositta chrysoptera*)	V		Yes	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett *et al.* 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Moderate
Painted Honeyeater (*Grantiella picta*)	V		Yes	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).	Low
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)		M	Yes Not recorded during	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 2007).	Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
			study		
Little Eagle (*Heiraaetus morphnoides*)	V*		Yes Not recorded during study	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Young fledge in early summer. Generation length has been estimated as 10 years (Debus and Soderquist 2008). It eats birds, reptiles and mammals, occasionally adding large insects and carrion (Marchant and Higgins 1993; Aumann 2001b; Debus *et al.* 2007).	Moderate
White-throated Needletail (*Hirundapus caudacutus*)		M	Yes Not recorded during study	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 2007)	High
Comb-crested Jacana (*Irediparra gallinacean*)	V		Yes	Occurs in floating vegetation of permanent well-vegetated wetlands and dams. Walks on floating plants. Occasionally feeds along muddy wetland margins on east coast of NSW (Garnett & Crowley 2000).	Low
Black Bittern (*Ixobrychus flavicollis*)	V		Yes	Usually found in dense vegetation in and fringing streams, swamps, tidal creeks and mudflats, particularly amongst swamp she-oaks and mangroves. Feeds on aquatic fauna along streams, in estuaries and beside billabongs and pools. Breeding occurs in summer in secluded places in densely vegetated wetlands. It nests in trees that overhang the water (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002n).	Low
Swift Parrot (*Lathamus discolor*)	E1	E	Yes	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, Swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coast's including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).	Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
Black-tailed Godwit (*Limosa limosa*)	V	M	Yes	A coastal species found on tidal mudflats, swamps, shallow river margins and sewage farms. Also, found inland on larger shallow fresh or brackish waters. A migratory species visiting Australia between September and May (Pizzey & Knight 2007).	Low
Square-tailed Kite (*Lophoictinia isura*)	V		Yes	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett & Crowley 2000).	Moderate
Hooded Robin (*Melanodryas cucullata*)	V		No	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).	Low
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V		Yes	Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).	Moderate
Rainbow Bee-eater (*Merops ornatus*)		M	Yes	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	Moderate
Black-faced Monarch (*Monarcha melanopsis*)		M	Yes	Occurs in rainforests, eucalypt woodlands, coastal scrubs, and damp gullies in rainforest, eucalypt forest and in more open woodland when migrating (Pizzey & Knight 2007).	Moderate
Satin Flycatcher (*Myiagra cyanoleuca*)		M	Yes	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 2007).	Moderate
Turquoise Parrot (*Neophema pulchella*)	V		Yes	Occurs in the foothills of the great dividing range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. Nests in hollows in trees, stumps or even fence posts. It feeds on seeds of both native and introduced grass and herb species (Garnett & Crowley 2000).	Moderate
Barking Owl (*Ninox connivens*)	V		Yes	Occurs in dry sclerophyll woodland. In the south west, it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	Moderate
Powerful Owl (*Ninox strenua*)	V		Yes	A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, *Casuarina* or *Callitris* pine forest and woodland. It often roosts in dense vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are	Moderate

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	
Flame Robin (*Petroica phoenicea*)	V		Yes	The Flame Robin is found in south-eastern Australia (Queensland border to Tasmania, western Victoria and south-east South Australia). In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains (Higgins and Peter 2002). There may be two disjunct breeding populations in NSW on the Northern Tablelands and the Central–Southern Tablelands (inferred from distributional data in Barrett et al. 2003 and the NSW Wildlife Atlas). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank. Generation length has been estimated as 5 years (Garnett and Crowley 2000).	Low
Scarlet Robin (*Petroica phoenicea)*	V		Yes	The Scarlet Robin is found in south-eastern Australia (extreme south-east Queensland to Tasmania, western Victoria and south-east South Australia) and south-west Western Australia. In NSW it occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter 2002). Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. The Scarlet Robin builds an open cup nest of plant fibres and cobwebs, sited in the fork of tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground (Higgins and Peter 2002; Debus 2006a,b).	Low
Superb Fruit-Dove (*Ptilinopus superbus*)	V		No	Occurs in rainforests and fringes, scrubs, mangroves and wooded stream-margins, lantana thickets, isolated figs, pittosporums, lilly pillies and blackberries (Pizzey & Knight 2007).	Low
Speckled Warbler (*Pyrrholaemus sagittatus*)	V		Yes	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett &	Moderate

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				Crowley 2000).	
Rufous Fantail (*Rhipidura rufifrons*)		M	Yes	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey & Knight 2007).	Moderate
Painted Snipe (*Rostratula benghalensis*)	E1	VM	Yes	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as Eucalyptus camaldulensis (River Red Gum), E. populnea (Poplar Box) or shrubs such as Muehlenbeckia florulenta (Lignum) or Sarcocornia quinqueflora (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	Low
Diamond Firetail (*Stagonopleura guttata*)	V		No	Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	Low
Freckled Duck (*Stictonetta naevosa*)	V		Yes	In most years, this species appear to be nomadic between ephemeral inland wetlands. In dry years, they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (Muehlenbeckia cunninghamii) within which they build their nests (Garnett & Crowley 2000).	Low
Masked Owl (*Tyto novaehollandiae*)	V		Yes	Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	Moderate
Sooty Owl (*Tyto tenebricosa*)	V		Yes	Occurs in wet eucalypt forest and rainforest on fertile soils with tall emergent trees. Typically found in old growth forest with a dense understorey but also occurs in younger forests if nesting trees are present nearby. It nests in large hollows within eucalypts and occasionally caves. It hunts in open and closed forest for a range of arboreal and terrestrial mammals including introduced species and sometimes birds (Garnett & Crowley 2000).	Moderate
Regent Honeyeater (*Xanthomyza phrygia*)	E1	EM	Yes	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei*	Moderate

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), E. melliodora (Yellow Box) and E. leucoxylon (Yellow Gum) (Garnett & Crowley 2000).	
Mammals					
Eastern Pygmy-possum (*Cercartetus nanus*)	V		No	Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree holes, between the wood and bark of a tree, abandoned birds nests and shredded bark in the fork of trees (Turner & Ward 1995).	Low
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	Yes	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Moderate
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	Yes	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service 1999h). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999f, 1999h).	Low
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V		Yes	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 2008)	Moderate
Eastern Bent-wing Bat (*Miniopterus schreibersii*)	V	C	Yes	Usually found in well timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 2008)	Moderate
Eastern Free-tail bat (*Mormopterus norfolkensis*)	V		Yes	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Solitary and probably insectivorous (Churchill 2008).	Moderate
Large-footed Myotis (*Myotis macropus*)	V		Yes	Colonies occur in caves, mines, tunnels, under bridges and buildings. Colonies always occur close to bodies of water where this species feeds	Low

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				on aquatic insects (Churchill 2008)	
Squirrel Glider (*Petaurus norfolcensis*)	V		Yes	Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999g).	Low
Brush-tailed Rock-wallaby (*Petrogale penicillata*)	E1	V	Yes	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003b).	Low
Koala (*Phascolarctos cinereus*)	V		Yes	Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum Eucalyptus tereticornis, Grey Gum E. punctata, Monkey Gum E. cypellocarpa and Ribbon Gum E. viminalis. In coastal areas, Tallowwood E. microcorys and Swamp Mahogany E. robusta are important food species, while in inland areas White Box E. albens, Bimble Box E. populnea and River Red Gum E. camaldulensis are favoured (NSW National Parks and Wildlife Service 1999e, 2003d).	Moderate
Long-nosed Potoroo (*Potorous tridactylus*)	V	V	No	Disjunct distribution along coastal south-east Australia from near Gladstone in Queensland, to south-west Victoria and in Tasmania. Found from sea level up to 1500 metres in altitude generally in areas with rainfall greater than 760 millimetres. In NSW, it is found throughout coastal and subcoastal areas. Occurs in a range of habitats: coastal forest and woodland with a moderately dense heathy understorey, dense coastal scrubs or heath, wet and dry sclerophyll forest and sub-tropical, warm temperate and cool temperate rainforest of the eastern slopes and highlands. Often associated with gullies and forest ecotones. Open areas are used for foraging while areas of dense groundcover or understorey provide areas for shelter and protection from predators. Relatively thick ground cover is a major habitat requirement and it seems to prefer areas with light sandy soils. Feeds at dusk on roots, tubers, fungi, insects and their larvae and other soft bodied animals in the soil. Moves up and down slope as food resources become seasonally available (Johnston 1995; NSW National Parks and Wildlife Service 1999h).	Low
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	Yes	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillies. It roosts in the	High

Species Name	TSC Act[1]	EPBC Act[2]	Recorded in locality[3]	Preferred habitat[4]	Likelihood of occurrence[5]
				branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001b)	
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V		Yes	Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 2008).	Moderate
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V		Yes	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically, it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 2008)	Moderate
Reptiles					
Broad-headed Snake (*Hoplocephalus bungaroides*)	E1	V	Yes	A nocturnal species that occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats, they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer (Webb, J.K. & Shine 1994; Webb, J.K & Shine 1998).	Low
Heath Monitor (*Varanus rosenbergi*)	V		No	Found in coastal heaths, humid woodlands, wet and dry sclerophyll forests. Mostly a terrestrial species it shelters in burrows, hollow logs and rock crevices (Cogger 2000).	Low

Notes:

1: TSC Act - *Threatened Species and Conservation Act 1995.* CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population, P = Protected (NPWS Act)

2. EPBC Act - *Environmental Protection and Biodiversity Conservation Act 1999.* CE = Critically Endangered, E = Endangered V = Vulnerable

3. ROTAP (Rare or Threatened Australian Plants (Briggs & Leigh 1996) is a conservation rating for Australian plants. Codes are:

- 1 Species only known from one collection
- 2 Species with a geographic range of less than 100 km in Australia
- 3 Species with a geographic range of more than 100 km in Australia
- X Species presumed extinct; no new collections for at least 50 years
- E Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
- V Vulnerable species at risk of long-term disappearance through continued depletion.
- R Rare, but not currently considered to be endangered.
- K Poorly known species that are suspected to be threatened
- C Known to be represented within a conserved area
- a At least 1,000 plants are known to occur within a conservation reserve(s).
- i Less than 1,000 plants are known to occur within a conservation reserve(s).

4. Based on database searches of a 10 km radius of site

5. Likelihood of Occurrence – see methods (below)

6. The species considered for assessment include all Threatened species known or predicted to occur within the sub-catchment region in which the study area is located.

Likelihood	Description
Low	Species considered to have a **low likelihood of occurrence** include species not recorded during the field surveys that fit one or more of the following criteria: Have not been recorded previously in the study area and surrounds and for which the study area is beyond the current distribution range. Use specific habitat types or resources that are not present in the study area. Are considered locally extinct. Are a non-cryptic perennial flora species that were specifically targeted by surveys.
Moderate	Species considered to have a **moderate likelihood of occurrence** include species not recorded during the field surveys that fit one or more of the following criteria: Have infrequently been recorded previously in the study area and surrounds. Use habitat types or resources that are present in the study area, although generally in a poor or modified condition. Are unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically during variable seasons or migration. Are cryptic flowering flora species that were not seasonally targeted by surveys.
High	Species considered to have a **high likelihood of occurrence** include species recorded during the field surveys or species not recorded that fit one or more of the following criteria: Have frequently been recorded previously in the study area and surrounds. Use habitat types or resources that are present in the study area that are abundant and/or in good condition within the study area. Are known or likely to maintain resident populations surrounding the study area. Are known or likely to visit the site during regular seasonal movements or migration.

References

Australian Museum 2003, *Great Egret factsheet*, Australian Museum,

Benson, D 2001, *Making bush regeneration work. Watercourses: conservation and regeneration*, Nature Conservation Council Urban Bushland Committee, Sydney.

Bishop, T 2000, *Field guide to the orchids of New South Wales and Victoria*, Second edn, University of New South Wales Press Pty. Ltd., Sydney.

Briggs, JD & Leigh, JH 1996, *Rare or Threatened Australian Plants*, CSIRO, Canberra.

Churchill, S 1998, *Australian Bats*, Reed New Holland, Sydney.

Churchill, S 2008, *Australian Bats*, 2nd edn, Allen & Unwin, Sydney.

Cogger, HG 2000, *Reptiles and Amphibians of Australia*, Reed Books, Sydney.

Department of Environment and Climate Change *Threatened Species Profile: Eucalyptus camfieldii* Department of Environment and Climate Change, viewed 5th June 2009 <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10287>.

Department of Environment and Climate Change 2005, *Apatophyllum constablei - profile*, Department of Environment and Climate Change, viewed 27/03/2009 2009, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10058>.

Department of Environment and Climate Change 2007, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Climate Change 2008, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2008, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2004, *Green and Golden Bell Frog environmental impact assessment guidelines* Department of Environment and Conservation (NSW), Hurstville.

Department of Environment and Conservation 2005a, *Brown Treecreeper (eastern subspecies) - Profile*, Department of Environment and Conservation, viewed 24 July 2009 2009, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10171>.

Department of Environment and Conservation 2005b, *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea)*, Department of Environment and Conservation (NSW), Hurstville, NSW,

Department of Environment and Conservation 2005c, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Primary Industries, WaE 2006, *Macquarie Perch- Macquaria australasica species information sheet (Primefacts)*.

Fairley, A 2004, *Seldom Seen: Rare Plants of Greater Sydney.*, 1st edn, Reed New Holland, Sydney.

Fairley, A & Moore, P 2002, *Native plants of the Sydney district. An identification guide*, Revised Edition edn, Kangaroo Press, Sydney.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2 (Revised Edition)*, 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

Higgins, PJ (ed.) 1999, *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

James, T 1997a, *Urban bushland biodiversity survey. Flora appendices.* , NSW National Parks and Wildlife Service, Hurstville,

James, T 1997b, *Urban bushland biodiversity survey. Native flora in western Sydney.* , NSW National Parks and Wildlife Service, Hurstville,

James, T, McDougall, L & Benson, D 1999, *Rare bushland plants of western Sydney*, Royal Botanic Gardens, Sydney.

Johnston, PG 1995, 'Long-nosed Potoroo', in R Strahan (ed.), *The Mammals of Australia*, Reed New Holland, Sydney, pp. 301-2.

McKilligan, N 2005, *Herons, egrets and bitterns: their biology and conservation in Australia*, CSIRO Publishing, Collingwood, Victoria.

NSW Fisheries 2004, *Status and monitoring of the Australian Grayling in NSW*, NSW Fisheries.

NSW National Parks and Wildlife Service 1999a, *Acacia bynoeana threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, *Bush Stone-curlew threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999c, *Cumberland Plain Large Land Snail threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999d, *Glossy Black-cockatoo threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999e, *Koala threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999f, *Spotted-tailed Quoll threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999g, *Squirrel Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999h, *Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.*,

NSW National Parks and Wildlife Service 2000a, *Persoonia glaucescens threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2000b, *Persoonia mollis ssp. maxima threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2000c, *Pimelea spicata threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2000d, *Threatened Species Information - Eucalyptus benthamii*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001a, *Giant Burrowing Frog threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001b, *Grey-headed Flying Fox threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001c, *Persoonia nutans threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002a, *Camarophyllopsis kearneyi (an agaric fungus) - endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002b, *Cynanchum elegans threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002c, *Epacris purpurascens var. purpurascens threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002d, *Hygrocybe anomala var. ianthinomarginata (an agaric fungus) - vulnerable species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002e, *Hygrocybe aurantipes (an agaric fungus) - vulnerable species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002f, *Hygrocybe austropratensis (an agaric fungus) - endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002g, *Hygrocybe collucera (an agaric fungus) - endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002h, *Hygrocybe griseoramosa (an agaric fungus) - endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002i, *Hygrocybe lanecovensis (an agaric fungus) - endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002j, *Hygrocybe reesiae (an agaric fungus) - vulnerable species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002k, *Hygrocybe rubronivea (an agaric fungus) - vulnerable species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002l, *Pultenaea parviflora threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002m, *Pultenaea pedunculata threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002n, *Threatened Species of the Upper North Coast of New South Wales - Fauna*, NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour.

NSW National Parks and Wildlife Service 2003a, *Acacia pubescens threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003b, *Brush-tailed Rock Wallaby Warrumbungles endangered population threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003c, *Draft Recovery Plan for the Bush Stone-curlew Burhinus grallarius*, National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003d, *Draft Recovery Plan for the Koala*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1997, *Final determination to list Acacia gordonii as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998a, *Final determination to list Grevillea parvilfora ssp. parviflora as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998b, *Final determination to list Melaleuca biconvexa as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998c, *Final determination to list Persoonia hirsuta as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998d, *Final determination to list Pimelea curviflora var curviflora as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999a, *Final determination to list Callistemon linearifolius as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999b, *Final determination to list Lasiopetalum joyceae as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999c, *Final determination to list Pultenaea pedunculata as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999d, *Final determination to list the Giant Barred Frog as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000a, *Final determination to list Grevillea parviflora ssp. supplicans as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000b, *Final determination to list Littlejohn's tree Frog as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2000c, *Final determination to list Wilsonia Backhousei as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2001, *Final Determination to list Hibbertia superans (a low spreading shrub) as an Endangered species*, Department of Environment and Conservation, <http://www.environment.nsw.gov.au/determinations/HibbertiaSuperansALowSpreadingShrubEndSpListing.htm>.

NSW Scientific Committee 2002a, *Final determination to list Caladenia tessellata as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2002b, *Final determination to list Micromyrtus minutiflora as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2002c, *Final determination to list the Diuris aequalis as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

Pizzey, G & Knight, F 2007, *Field Guide to the Birds of Australia*, Harper and Collins, Sydney.

Robinson, L 1994, *Field guide to the native plants of Sydney*, Kangaroo Press, Sydney.

Royal Botanic Gardens 2004, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Royal Botanic Gardens 2005, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Sharp, D & Simon, BK 2002, *AusGrass: Grasses of Australia, CD-ROM, Version 1.0*, Australian Biological Resources Study, Canberra, and Environmental Protection Agency, Queensland.,

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*, Department of Primary Industries, Water and Environment, Hobart.

Threatened Species Scientific Committee 2008, *Commonwealth Listing Advice on Thelymitra sp. Kangaloon (D.L.Jones 18108)*,

Traill, BJ & Duncan, S 2000, *Status of birds in the New South Wales temperate woodlands region*, Consultancy report to the NSW National Parks and Wildlife Service by the Australian Woodlands Conservancy, Chiltern, Victoria.

Turner, V & Ward, SJ 1995, 'Eastern Pygmy-possum', in R Strahan (ed.), *The Mammals of Australia*, Reed New Holland, Sydney, pp. 217-8.

Webb, JK & Shine, R 1994, *Habitat use by the broad-headed snake, Hoplocephalus bungaroides*, Environment Australia, Canberra.

Webb, JK & Shine, R 1998, 'Ecological characteristic of an endangered snake species *Hoplocephalus bungaroides* (Serpentes: Elapidae)', *Animal Conservation*, vol. 1, pp. 185-93.

Appendix E

Plant Species List

Class Name	Scientific Name	Common Name	Native	TSC Act	EPBC Act	Vegetation Condition Type 1	Vegetation Condition Type 2	Vegetation Condition Type 3
Adiantaceae								
	Cheilanthes sieberi	Mulga Fern	Y	-	-	-	-	S
Amaranthaceae								
	Alternanthera denticulata	Lesser Joyweed	Y	-	-	S	-	-
Asparagaceae								
	Asparagus aethiopicus	Asparagus Fern	N	-	-	-	S	S
	Asparagus asparagoides		N	-	-	-	-	S
	Asparagus officinalis	Asparagus	N	-	-	-	S	-
Asteraceae								
	Aster subulatus	Wild Aster	N	-	-	S	-	-
	Conyza bonariensis	Flaxleaf Fleabane	N	-	-	S	S	-
Chenopodiaceae								
	Einadia hastata	Berry Saltbush	Y	-	-	-	-	S
	Einadia polygonoides		Y	-	-	-	S	S
	Einadia trigonos	Fishweed	Y	-	-	-	-	S
Commelinaceae								
	Commelina cyanea	Native Wandering Jew	Y	-	-	S	S	-
Fabaceae (Faboideae)								
	Glycine clandestina		Y	-	-	-	-	S
	Indigofera australis		Y	-	-	-	-	S
Goodeniaceae								
	Brunonia australis	Blue Pincushion	Y	-	-	-	-	S
Malvaceae								
	Modiola caroliniana	Red-flowered Mallow	N	-	-	-	S	-
	Sida rhombifolia	Paddy's Lucerne	N	-	-	S	S	S
Myrtaceae								
	Eucalyptus moluccana	Grey Box	Y	-	-	S	S	S
Poaceae								
	Chloris truncata	Windmill Grass	Y	-	-	-	S	S
	Cynodon dactylon	Common Couch	Y	-	-	S	S	-
	Eragrostis leptostachya	Paddock Lovegrass	Y	-	-	-	-	S
	Eriochloa pseudoacrotricha	Early Spring Grass	Y	-	-	-	S	-

Class Name	Scientific Name	Common Name	Native	TSC Act	EPBC Act	Vegetation Condition Type 1	Vegetation Condition Type 2	Vegetation Condition Type 3
	Microlaena stipoides		Y	-	-	S	-	-
	Oplismenus aemulus		Y	-	-	S	-	-
	Paspalidium distans		Y	-	-	-	S	-
	Paspalum dilatatum	Paspalum	N	-	-	S	S	-
	Pennisetum clandestinum	Kikuyu Grass	N	-	-	S	-	S
	Setaria gracilis	Slender Pigeon Grass	N	-	-	S	S	S
Ranunculaceae								
	Ranunculus inundatus		Y	-	-	S	-	-
Rosaceae								
	Rubus ssp.	Blackberry	N	-	-	S	-	-
Solanaceae								
	Solanum nigrum	Black-berry Nightshade	N	-	-	-	S	-
	Solanum pungetium	Eastern Nightshade	Y	-	-	-	-	S
Verbenaceae								
	Verbena bonariensis	Purpletop	N	-	-	S	-	-

SECTION K

Appendix 3 – Acoustic Assessment

RECYCLED WATER FACTORY
CNR BOOTLES LANE AND JOHNSTON STREET, PITT TOWN

ACOUSTIC ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 10081
VERSION A

WILKINSON MURRAY

RECYCLED WATER FACTORY
CNR BOOTLES LANE AND JOHNSTON STREET, PITT TOWN

ACOUSTIC ASSESSMENT

REPORT NO. 10081
VERSION A

MARCH 2010

PREPARED FOR

WATER FACTORY COMPANY
C/- DBL PROPERTY
PO BOX A966
SYDNEY SOUTH NSW 1235

Wilkinson Murray (Sydney) Pty Limited · ABN 39 139 833 060
Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Offices in SE Qld & Hong Kong**
t +61 2 9437 4611 • **f** +61 2 9437 4393 • **e** acoustics@wilkinsonmurray.com.au • **w** www.wilkinsonmurray.com.au

TABLE OF CONTENTS

1 INTRODUCTION

Water Factory Company is seeking a licence under WICA, to construct and operate a Recycled Water Factory on a small parcel of land located at the north western corner of Bootles Lane and Johnston Street, Pitt Town (Lot 1062, DP 1131838), in Sydney's north western region.

A Recycled Water Factory, also known as sewer mining, takes waste water from a suburban sewer line and treats it in order to produce high quality water suitable for use in irrigation, car washing and other non-potable uses such as toilet flushing. The process is an automated one with only a single daily daytime inspection required. Major plant will be located within an enclosure. This report addresses the noise impacts associated with operation of the facility in accordance with the Department of Environment, Climate Change and Water (DECCW) guidelines and criteria.

2 SITE DESCRIPTION

The proposed location of the facility is at the north western corner of Bootles Lane and Johnston Street in Pitt Town, adjacent to a minor submersible sewage pumping station operated by Hawkesbury City Council. The area is predominately rural in nature and the site is bounded by Bootles Lane to the south, Johnston Street to the east and the sewage pumping station (SPS) immediately to the north. A small number of residences are currently located in the vicinity of the site, to the south and to the east of the site. The potentially most affected dwelling is located immediately to the east of the site (24 Bootles Lane), across Johnston Street. Figure 2-1 shows the subject area and nearest residences.

Figure 2-1 Site Location

In addition to the aforementioned existing residential properties, we note that as part of Pitt Town Masterplan, a number of residential estates (some 943 lots) will be built in the area. Those closest to the site will lie mainly to the north and east of the site, and lie at least 200m from the site, further than the existing residences.

3 DESCRIPTION OF FACILITY

A similar facility to this has been successfully installed at the Pennant Hills Golf Course, although the Pitt Town facility will have vastly different architectural treatment.

An operations building will house plant and equipment involved in water treatment processes. The building is approximately 20m x 10m giving an overall area of 200m^2 with a skillion roof ranging from 3m to 4.8m height across its width. The building will have a mix of Colorbond and off-form concrete materials in natural and muted grey colours in its facades, and dressed with narrow bands of glass windows to soften the elevations. In particular the elevation from Bootles Lane aims to simulate a rural residential feel. The north elevation will carry a roller door for access to the facility from the service drive for any large components. The roof will also be of Colorbond material.

A second building enclosing treatment tanks will sit separately but aligned with the operations building. The building is also 20m x 10m (200m^2) and approx 5.2m height above ground level to the top of the parapet which will be 1.2m above the finished roof level of the tank. The building will also sit a further 2m into the ground to reduce its apparent height and scale. It will be constructed of off-form concrete panels in natural colours. A staircase at the rear of the building will provide access to the roof of the structure for servicing purposes.

A 4m wide breezeway will separate the above two buildings. The breezeway will have a canopy of steel and Colorbond materials for weather protection, and to visually link the buildings. The breezeway will assist in providing cover for any visitors to the site for inspections, outside of the operations areas.

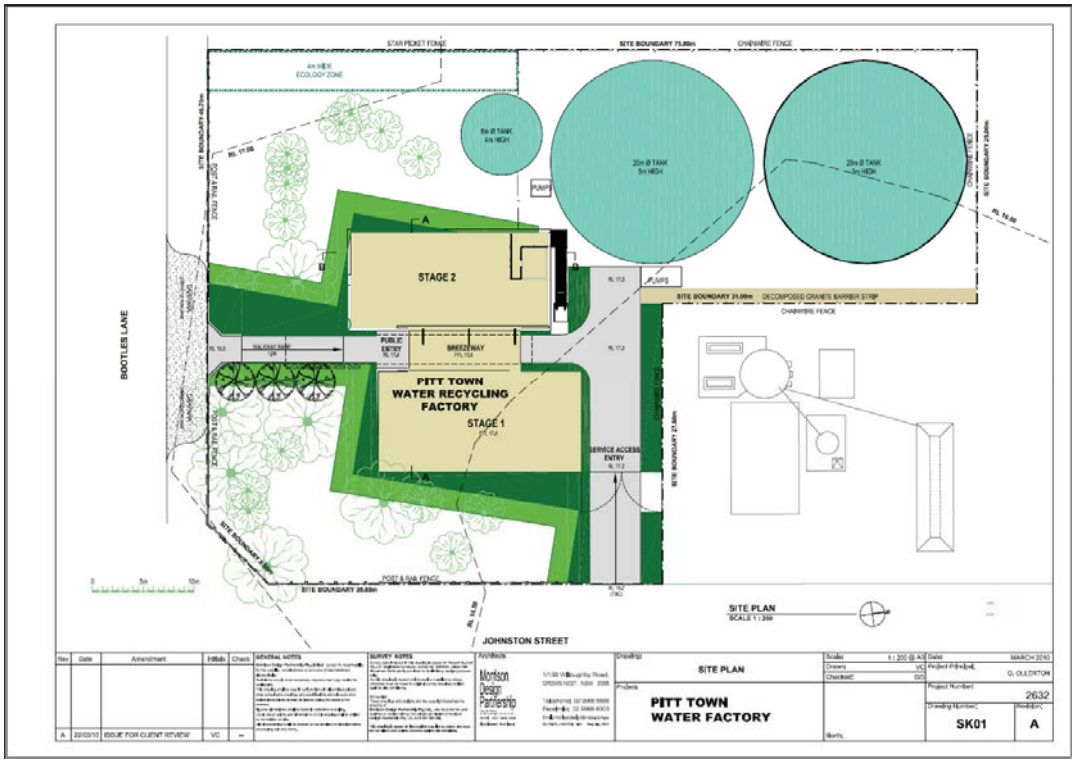
The facility buildings will contain plant items including fine filter banks, dosing pumps, compressors, air blowers, screens and mixers.

Two tanks to store treated waste water will be located to the north of the treatment plant. Capacity will be 2 million litres each, and will stand 5m height above ground level, and 20m diameter. The tanks are constructed of steel and sit in a compacted earth and gravel area. A tank for storage of sewage material ready for treatment (referred to as a Balance Flow Tank) will sit to the west of the treatment tanks. Its size is 8m diameter and 4m height. The tank is also constructed of steel. The tanks will be interconnected with pipes and pumps and the like to each other, and to the treatment plant building.

The overall facility is fully automated and will operate as such 24 hours a day, 7 days a week. A single daytime inspection would be carried out daily.

The proposed layout of the Facility is illustrated schematically in Figure 3-1.

Figure 3-1 Schematic Illustration of Site Layout relative to Location



Note: North lies to the right of the page.

The top of the reactor tank located on the roof of the equipment building at the Pennant Hills Golf Course installation is open to the air, and covered with a metal grid and carpet. This allows some noise emission from the running water in the reactor tank, albeit at a reduced noise level. It is understood that at the Pitt Town installation, the top of the Facility tank will be partially enclosed, thus reducing this source of noise emission. For a conservative assessment, it has been assumed that the top of the tank would be left open (similar to the Pennant Hills Golf Course facility) and this noise source has been included in the calculations.

4 NOISE ASSESSMENT GUIDELINES AND CRITERIA

This section of the report discusses noise guidelines and criteria for the assessment of operational noise. Appropriate criteria are contained within the NSW Department of Environment & Climate Change and Water (DECCW) *NSW Industrial Noise Policy (INP).*

4.1 Industrial Noise Policy

The *INP* is designed to assess noise using the more stringent of the following two approaches:

- Intrusive noise impacts in the short term for residences; and
- Amenity for particular land uses such as residences.

The *INP's* intrusive noise goal is the noise level 5dBA above the background noise level for each time period (daytime, evening or night time) of interest. The background noise level is derived from the measured L_{A90} noise levels.

The amenity goal sets an upper limit to the total industrial noise level ($L_{Aeq,period}$) in an area from all industrial noise sources (existing and future). The criterion depends on the time of day, area classifications and the relationship of the total measured $L_{Aeq,period}$ (and contribution from existing industrial noise) to determine the Acceptable Noise Level (ANL) for the development. Traffic noise would also be taken into account in areas where the noise environment is significantly affected by traffic noise.

The potentially affected area is classified as Rural by the *INP*. Given this, the acceptable amenity noise levels ($L_{Aeq,period}$ dBA) which apply over the whole day, evening or night period are as follows and are applicable only to noise from industrial sources:

- Daytime 50dBA
- Evening 45dBA
- Night time 40dBA

In summary, the overall industrial noise from all industrial noise sources in the area (including the subject development) should not exceed the above amenity noise levels over the day evening and night periods. These criteria are applicable within 30m from the dwelling, in accordance with the *INP.*

4.2 Sleep Disturbance

Maximum noise level events during the night time period have the potential to result in sleep disturbance. The DECCW recommends that the potential for high noise level events at night and the effects on sleep should be addressed. Night time is defined to be the period between 10.00pm and 7.00am.

It is recognised that sleep disturbance is a complex issue dependant on large number of variables such as sex, health, number of maximum noise level events, background noise level and a number of other variables. There is yet no definitive correlation relating maximum noise levels and sleep disturbance and research continues.

Currently, DECCW recommend a sleep disturbance criterion of an $L_{A1,(1\ minute)}$ not exceeding the $L_{A90,\ (15\ minute)}$ by more than 15dBA, assessed within 1m to a bedroom window. It is acknowledged that this criterion is conservative, however is used as a test to determine the potential for sleep disturbance.

5 NOISE MONITORING AND AMBIENT NOISE LEVELS

In order to establish project specific noise criteria, it is necessary to quantify the prevailing ambient noise levels. Accordingly, unattended ambient noise monitoring was carried within the grounds of the potentially most affected residential property (24 Bootles Lane), located immediately to the east of the site. The noise logger was located adjacent to the Johnston Street frontage of the dwelling, away from the dwelling itself in order to minimise extraneous noise from the dwelling. The noise levels here are considered to be representative of the general area.

The noise monitoring was conducted using an ARL Environmental Noise Loggers type EL-215 between Monday, 8 March 2010 and Monday, 15 March 2010 at the location shown in Figure 5-1. The weather conditions during the survey period were generally fine with no significant rain or windy periods.

The noise logger was programmed to continuously monitor noise and record data at the end of each 15 minute time period within the overall survey period. Calibration was checked before and after the noise survey. Drift in calibration was found to be less than 0.5dBA, which is well within acceptable tolerances.

Figure 5-1 Ambient Noise Monitoring Location

The results of noise measurements were processed based on the guidelines contained within the NSW Department of Environment & Climate Change and Water (DECCW) guideline document, the *Industrial Noise Policy (INP),* in order to establish relevant noise descriptors. The full results of measurements are shown in graphical form in Appendix B.

The graphs in Appendix B show the noise environment throughout each day of the measurement period. For each 15 minute period over the week long period the graph shows:

- The L_{A90} measured in that 15 minute period (the background);
- The L_{Amax} measured in that 15minute period (the highest level); and
- The L_{Aeq} measured in that 15 minute period – that is the energy average of the sound received at the microphone in that 15 minutes.

This is further described by the graph in Appendix A, which shows a typical trace of noise level over a 15 minute period, and the relationship of that trace to the L_{A90} and L_{Aeq}.

The L_{A90} and L_{Aeq} constantly vary over the measurement period. So to set noise criteria, the L_{A90} and L_{Aeq} levels are summarised by the Rating Background Level (RBL) and the $L_{Aeq,period}$ noise levels, and these summaries are used to establish the relevant intrusive and amenity noise criteria.

The RBLs for daytime, evening and night time are determined from the measured L_{A90} levels shown on the graphs. The INP describes a statistical procedure to determine the RBL based on the measured L_{A90} levels in all relevant 15 minute periods. In this way the RBL represents a background noise level that is not the absolute lowest recorded, but considered statistically to provide a baseline for a suitable noise goal to protect the amenity of the area.

The $L_{Aeq,period}$ for daytime, evening and night time are determined by logarithmically averaging the levels measured in each 15 minute measurement over the logging period.

The RBL's and $L_{Aeq,period}$ levels are shown in Table 5-1. We note that the L_{Aeq} noise levels were not generated by any industrial noise source, but by general environmental and community based noise sources (eg birds etc).

Table 5-1 Monitored Ambient Noise Levels at Residences

Location	Descriptor	Noise Level – (dBA) re 20 µPa		
		Daytime	**Evening**	**Night Time**
		7.00am-6.00pm	**6.00-10.00pm**	**10.00pm-7.00am**
Eastern dwelling	RBL	39	36	32
(24 Bootles Lane)	$L_{Aeq,period}$	49	46	46

Note: $L_{Aeq,period}$ noise levels here are not controlled by industrial noise sources. Noise from the existing pumping station operated by Hawkesbury Council is barely audible, even at the boundary of the pumping station site.

6 PROJECT SPECIFIC NOISE CRITERIA

6.1 Industrial Noise Policy Noise Level Criteria

Because the Recycled Water Factory would operate day and night, the limiting criterion will therefore be the night time criterion. If the noise complies at night time, compliance during daytime and evening will then follow.

Table 6-1 presents a summary of the intrusiveness noise criteria for the existing residential receivers surrounding the proposed site using the background noise levels presented in Table 5-1.

Table 6-1 Intrusive Noise Level Criteria, $L_{Aeq,15minutes}$

Location	Daytime	Evening	Night
Intrusive noise criteria, $L_{Aeq,15minutes}$	44	41	37

Note: Noise level applicable within 30m from a dwelling and applicable to this facility only

The night time project specific amenity criterion will be $L_{Aeq,9hr}$ 40dBA, therefore the limiting criterion will be the intrusive noise criteria presented in Table 6-1.

It is conservatively assumed for the purpose of this assessment that the noise level over the worst case 15 minute period would be equivalent to the noise level over the whole night time period, even though the operating cycles of pumps might vary.

Hence the night-time noise criterion of $L_{Aeq,15minutes}$ 37dBA is adopted for all residences. Compliance with this would lead to compliance with the amenity criterion. This criterion is applicable to noise from the development only, and is applicable within 30m from a residence.

6.2 Sleep Disturbance Criteria

The primary sleep arousal criteria adopted for this project is 52dBA during the night time period based on the measured night time RBL noise level plus 15dBA.

7 SITE NOISE EMISSION LEVELS

7.1 Calculation Method

Noise levels were calculated using the CADNA A computer modelling program based on ISO 9613 algorithms. Using CADNA A it is possible to build a model of the Facility noise sources and the surrounding area. The model is capable of taking account of the following parameters:

- noise source levels;
- topography between the reactor and the residences;
- any shielding by buildings between noise sources and receivers; and
- meteorological effects which could change noise propagation.

Because the Facility is well within 300m of the nearest residences, meteorological enhancement of noise propagation are not significant and have not been considered in the assessment.

Noise modelling was undertaken based on noise emission levels from noise measurements at a similar facility at Pennant Hills Golf Course. The noise levels are summarised in Table 7-1.

Table 7-1 Noise Source Levels

Equipment or Location	Sound Level
Macerator	L_{Aeq} 65dBA sound power level
Balance Pump	L_{Aeq} 70dBA sound power level
Treated Water Pump	L_{Aeq} 67dBA sound power level
Fine Filter Bank	L_{Aeq} 70dBA sound power level
Equipment Room, 1 blower operating	L_{Aeq} 66dBA reverberant sound pressure level
Equipment Room, 1 blower and 1 compressor operating	L_{Aeq} 75dBA reverberant sound pressure level
At top of tanks (running water sound)	Typical noise 65dBA, approx. 10m^2 open area

Noise levels were calculated to the nearest residential properties and are presented in Section 8.

7.2 Noise Emission Levels

The results of the calculation are shown in Table 7-2.

Table 7-2 Predicted $L_{Aeq,15minutes}$ Noise Levels at Residences (within 30m of dwelling)

Operating Condition	Eastern Dwelling (24 Bootles Lane)	Southern Dwellings
All equipment operating	32dBA	25dBA

Note: Noise levels predicted within a 30m curtilage of dwelling, consistent with the *INP* procedures.

The noise levels are well within the limiting 37dBA night time noise criterion at all locations.

7.3 Tonality of Noise

There is some potential that the noise may be tonal in character. According to the INP, a modification factor of 5dBA should be added to account for the higher intrusiveness of the noise in such circumstances. Should a 5dBA modification factor be applicable, the noise level would still comply with the 37dBA noise criterion at all locations.

7.4 Assessment of Sleep Disturbance

During the measurements at Pennant Hills Golf Course it was noted that there was one potential noise source with short-term maximums; that is, the operational relief valve on the compressors in the equipment room. The $L_{A1,1min}$ of this noise level is estimated to be 9dB higher than the continuous L_{Aeq} noise level. The predicted $L_{A1,1min}$ noise level is then up to 41dBA at the nearest dwelling to the east and 34dBA at the dwellings to the south, well within the sleep disturbance objective of 52dBA, therefore no impact is expected.

8 RECOMMENDATION

It is recommended that following commissioning of the facility, noise measurements be undertaken to confirm compliance with the noise criteria outlined within this report.

9 CONCLUSION

Noise from the proposed Recycled Water Factory at Pitt Town has been assessed.

The assessment was based on actual operating noise measured at an existing Recycled Water Facility at Pennant Hills Golf Course.

Noise from the Facility is predicted to comply with the limiting noise criteria established in accordance with the DECCW's NSW Industrial Noise Policy. No loss of acoustic amenity is expected at the potentially most affected residential properties adjacent to the facility.

Version	Status	Date	Prepared by	Checked by
A	Final	26 March 2010	Glenn Homes	John Wassermann

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

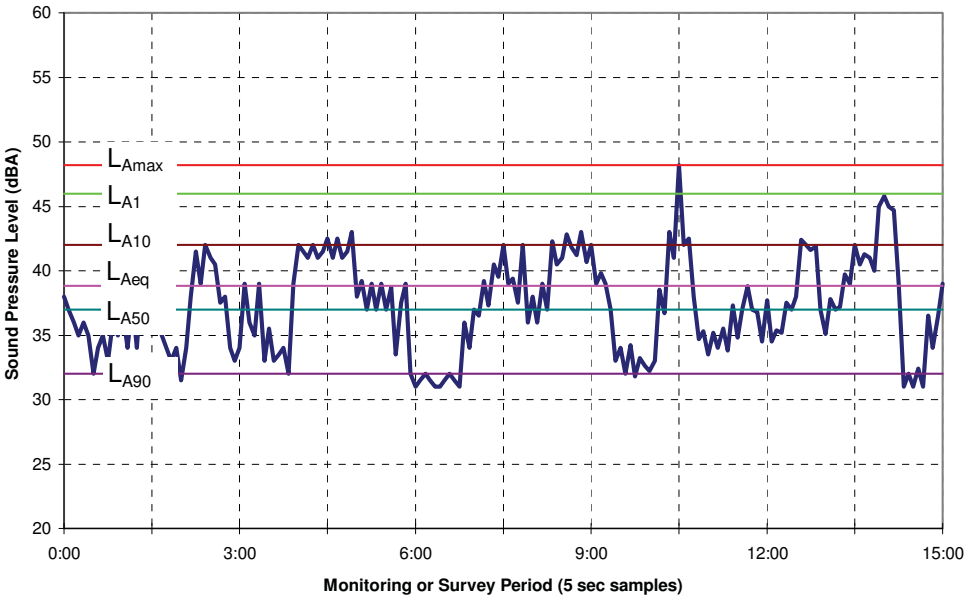
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.

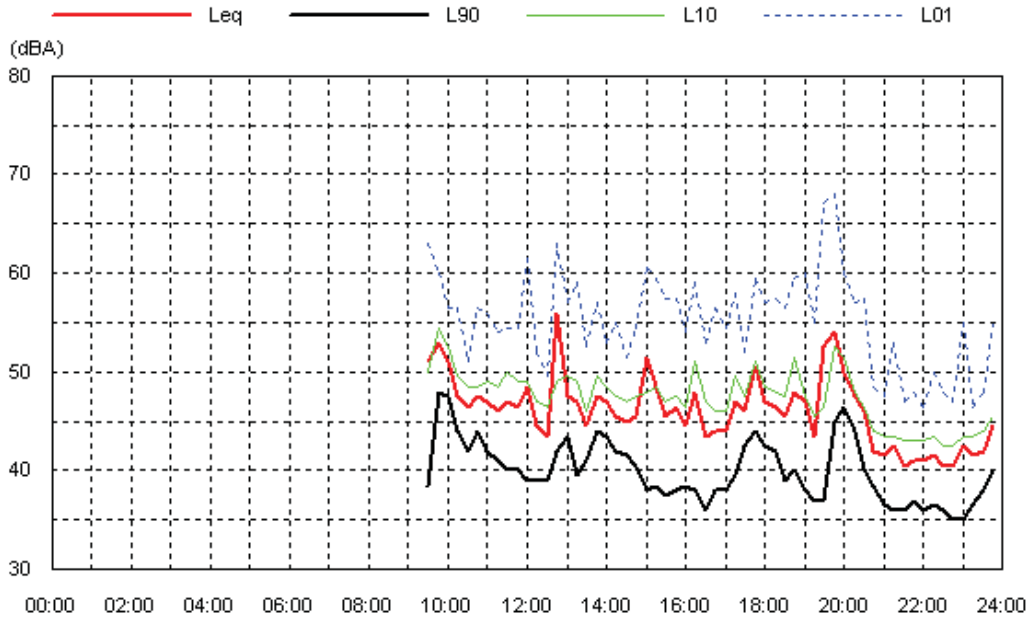

60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

NOISE MEASUREMENT RESULTS

Location: 24 Bootles Lane, Pitt Town

Mon 08 Mar 10



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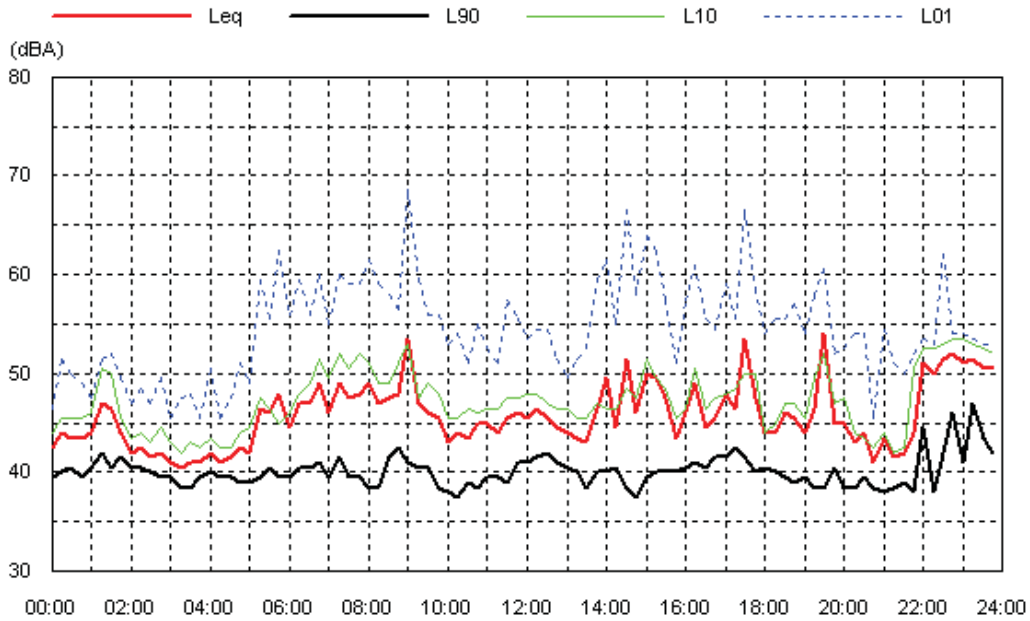

Location: 24 Bootles Lane, Pitt Town

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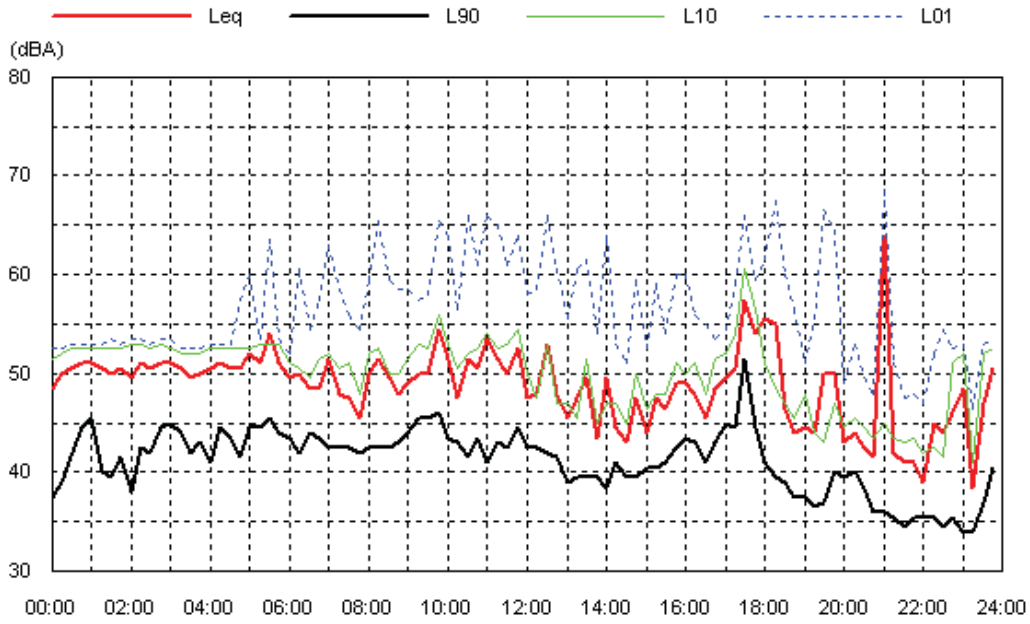

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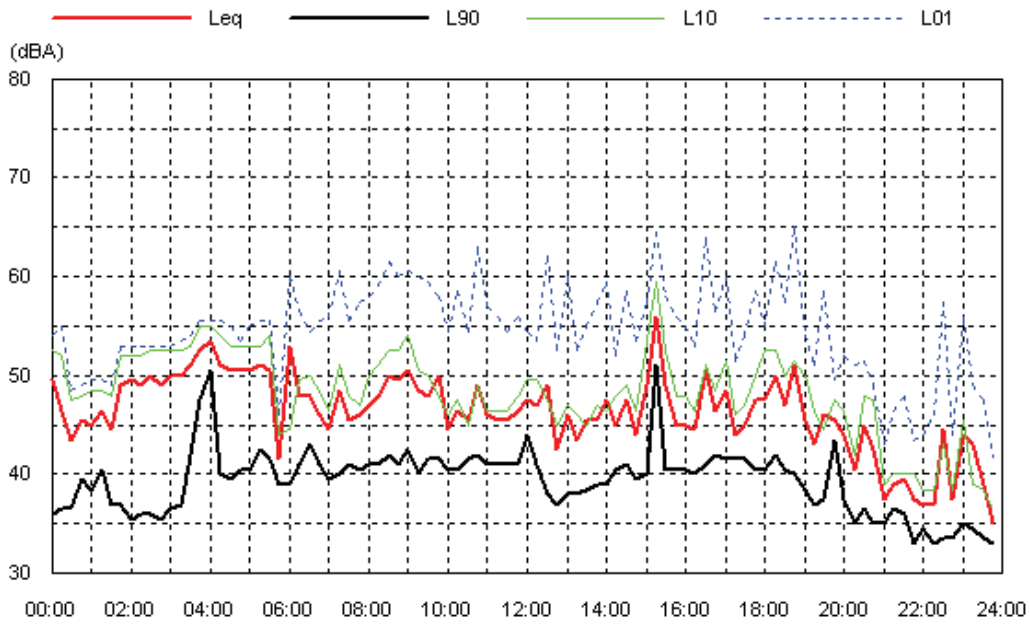
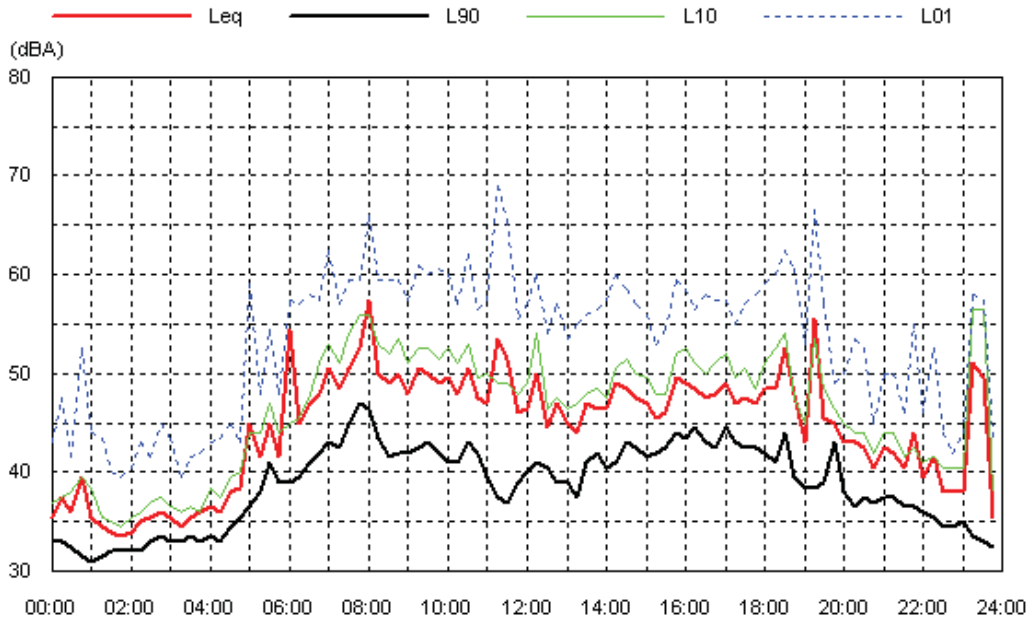


Location: 24 Bootles Lane, Pitt Town

Fri 12 Mar 10



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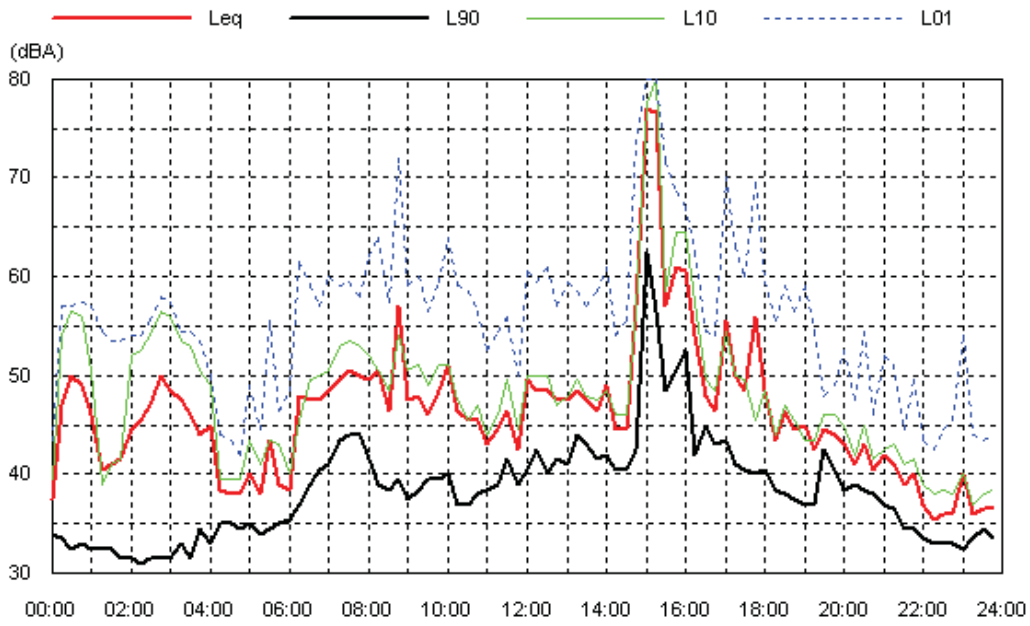
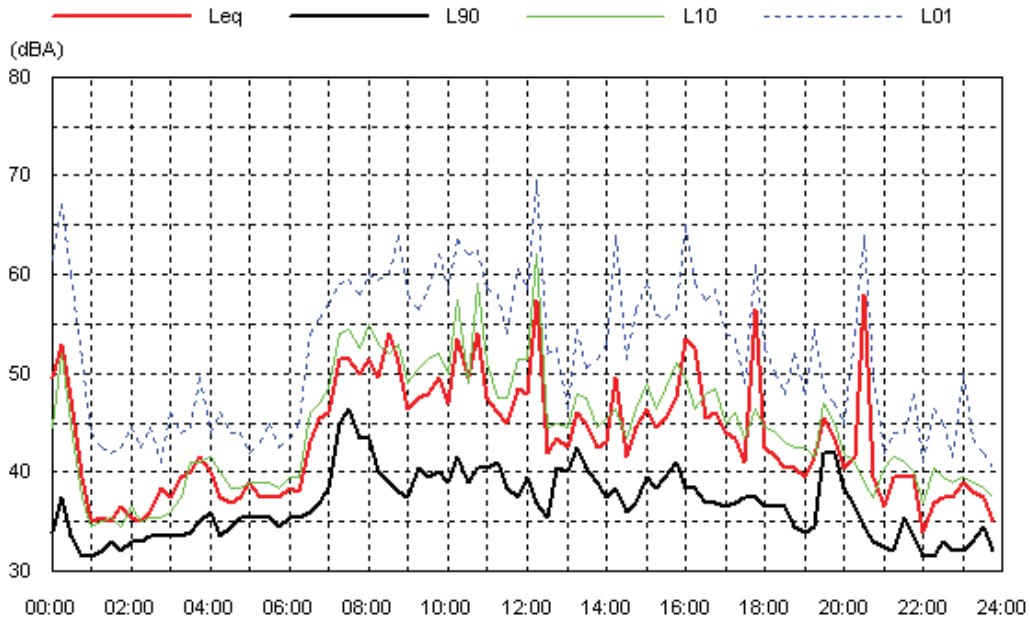
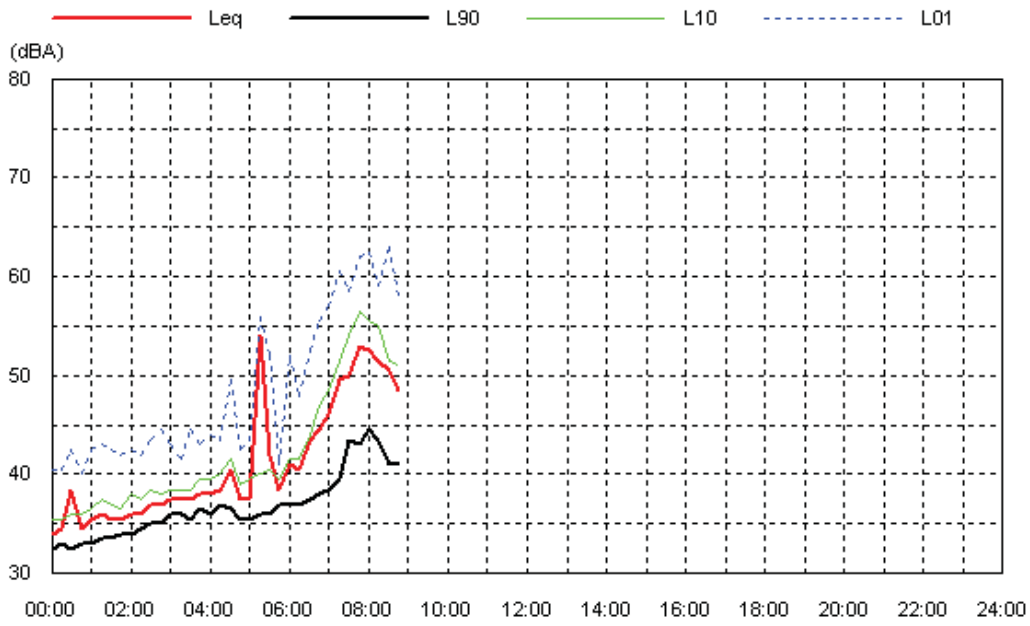


Location: 24 Bootles Lane, Pitt Town

Sun 14 Mar 10



Mon 15 Mar 10



SECTION K

Appendix 4 – Odour Impact Assessment

ODOUR IMPACT ASSESSMENT

PITT TOWN RECYCLED WATER FACTORY

DBL Property on behalf of Water Factory Company

Job No: **3840**

29 March 2009

A PEL Company

PROJECT TITLE:	**PITT TOWN RECYCLED WATER FACTORY**
JOB NUMBER:	**3840**
PREPARED FOR:	Brendan Seage **DBL PROPERTY ON BEHALF OF WATER FACTORY COMPANY**
PREPARED BY:	Philip Henschke
APPROVED FOR RELEASE BY:	Judith Cox
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DOCUMENT CONTROL

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

SYDNEY:
Suite 2B, 14 Glen Street
Eastwood NSW 2122
Ph: +61 2 9874 8644
Fax: +61 2 9874 8904

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

Email: info@paeholmes.com

Website: www.paeholmes.com

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1 INTRODUCTION

This report has been prepared by PAEHolmes on behalf of DBL Property who are acting for Water Factory Company Pty Ltd. It provides an assessment of the potential odour impacts from the proposed Recycled Water Factory (RWF) to be located on the corner of Bootles Lane and Johnston Street, Pitt Town, NSW. The location of the site is shown in **Figure 1**.

The report comprises the following components.

- Description of the project
- Discussion of air quality issues with respect to odour
- Review of the dispersion meteorology in the area
- An assessment of potential impacts

2 BACKGROUND

The Water Factory Company is proposing to submit an application to the Independent Pricing and Regulatory Tribunal (IPART) to obtain a licence under Water Industry Competition (WIC) Act to construct and operate a Recycled Water Factory at a site in Pitt Town near Windsor.

The intended Recycled Water Factory will utilise sewage from a Hawkesbury City Council (HCC) trunk mains to produce water. The facility is intended to operate 24 hours, 7 days per week, housed in a low-scale, single level building.

The only source of odour is from the screens used to remove inorganic material larger than 3 mm in size from the flow, prior to treatment of the liquid flow. The screens are entirely enclosed, however, there are three pump locations where fugitive odour emissions can escape (see **Figure 2**). Odour samples have been previously collected from the screens at an existing facility located at Pennant Hills Golf Course.

A HCC sewerage pumping station (SPS) is located adjacent to the site and it is proposed to source the sewerage material from this existing SPS for the RWF.

The pump station has been constructed to HCC standards and includes a venting and odour control system that is designed to minimise odours during normal flow conditions. The operation of the pump station is not controlled by the RWF applicant, however is not considered to be a significant source of odour and as such has not been considered in this study.

Figure 1: Site Location

Figure 2: Location of emission points (Pennant Hills Golf Course)

3 DISCUSSION OF AIR QUALITY ISSUES

3.1 Measuring odour concentration

There are no instrument-based methods that can measure an odour response in the same way as the human nose. Therefore "dynamic olfactometry" is typically used as the basis of odour management by regulatory authorities.

Dynamic olfactometry is the measurement of odour by presenting a sample of odorous air to a panel of people with decreasing quantities of clean odour-free air. The panellists then note when the smell becomes detectable. The correlations between the known dilution ratios and the panellists' responses are then used to calculate the number of dilutions of the original sample required to achieve the odour detection threshold. The units for odour measurement using dynamic olfactometry are "odour units" (ou) which are dimensionless and are effectively "dilutions to threshold". The detectability of an odour (i.e. whether someone smells it or not) is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. The theoretical minimum concentration is referred to as the "odour threshold" and is the definition of 1 odour unit (ou). Therefore, an odour concentration of less than 1 ou would theoretically mean there is no odour.

Olfactometry can involve a "forced choice" end point where panellists identify from multiple sniffing ports the one where odour is detected, regardless of whether they are sure they can detect odour. There is also a "yes/no" or "free choice" endpoint where panellists are required to say whether or not they can detect odour from one sniffing port. Forced choice olfactometry generally detects lower odour levels than yes/no olfactometry and is the preferred method for use in Australia.

In both cases, odorous air is presented to the panellists in increasing concentrations. For the forced-choice method, where there are multiple ports for each panellist, the concentration is increased until all panellists consistently distinguish the port with the sample from the blanks. For a yes/no olfactometer (which has only one sniffing port) one method used is to increase the concentration of odour in the sample until all panellists respond. The sample is then shut off and once all panellists cease to respond, the sample is introduced again at random dilutions and the panellists are asked whether they can detect the odour.

During the 1990s significant research was undertaken in Europe to refine the olfactometry method. This led to considerable improvements in panellist management and standardisation and, importantly, clear criteria for repeatability and reproducibility of results.

The draft Committé Européen de Normalisation (CEN) odour measurement standard (**CEN,**

1996) is a performance based standard with strict criteria for repeatability and reproducibility. The Australian standard (introduced in September 2001) (**Standards Australia, 2001**) is based upon the CEN standard.

As with all sensory methods of identification there is variability between individuals. Consequently the results of odour measurements depend on the way in which the panel is selected and the way in which the panel responses are interpreted.

As the plant is not yet operational, odour samples were collected from an existing operation at Pennant Hills Golf Course and analysed in accordance with the Australian Standard. The results from this analysis have been used for this assessment.

3.2 Odour performance criteria

3.2.1 Introduction

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 NSW Department of Environment and Climate Change and Water (DECCW) has developed odour goals and the way in which they should be applied with dispersion models to assess the likelihood of nuisance impact arising from the emission of odour.

There are two factors that need to be considered:

1. what "level of exposure" to odour is considered acceptable to meet current community standards in NSW and
2. 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 so-called **FIDOL** factors):

- the **F**requency of the exposure
- the **I**ntensity of the odour
- the **D**uration of the odour episodes and
- the **O**ffensiveness of the odour
- the **L**ocation of the source

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 etc., 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 FIDOL 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.

3.2.2 Complex mixtures of odorous air pollutants

The DECCW Approved Methods **(NSW DEC, 2005)** include ground-level concentration (glc) criterion for complex mixtures of odorous air pollutants. They have been refined by the DECCW to take account of population density in the area. **Table 3.1** lists the odour glc criterion to be exceeded not more than 1% of the time, for different population densities.

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.

The most stringent of the impact assessment criterion of 2 ou (at the 99th percentile) has been applied for this assessment **(NSW DEC, 2005)**.

Table 3.1: Odour Performance Criteria for the Assessment of Odour

Population of affected community	glc criterion for complex mixtures of odorous air pollutants (ou)
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (2000) and/or schools and hospitals	2

3.3 Peak-to-mean ratios

It is common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because Gaussian dispersion models are only able to directly predict concentrations over an averaging period of 3-minutes or greater. The human nose, however, responds to odours over periods of the order of a second or so. During a 3-minute period, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

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 DECCW commissioned a study by **Katestone Scientific Pty Ltd (1995, 1998)**. This study recommended peak-to-mean ratios for a range of circumstances. The ratio is also dependent on atmospheric stability (discussed in **Section 4.2**) and the distance from the source. For point sources in the far field, there are range of peak-to-mean ratios, depending on the height of the stack and whether the source is wake-affected or not. In this case, a conservative approach has been taken, and the values for a surface wake-free point in the far-field have been applied, that, the peak to-mean ratio is 4 for stability classes A to C, and 7 for stability classes D to F. A summary of the factors is provided in **Appendix A**.

The DECCW Approved Methods take account of this peaking factor and the goals shown in **Table 3.1** are based on nose-response time.

4 LOCAL METEOROLOGY

This section describes the dispersion meteorology in the study area. Information on prevailing wind patterns, atmospheric stability and climatic conditions are presented.

4.1 Wind speed and direction

Meteorological data are collected at the Richmond RAAF Bureau of Meteorology (BoM) station, approximately 8.5 km west-southwest of the site. A windrose of the data collected from this site is presented in **Figure 3**; the annual average wind speed for this site is 3.5 m/s.

Sigma-theta is not a measured parameter at the Richmond RAAF BoM site but is required for dispersion modelling. The nearest weather station that collects this measured parameter is operated by the NSW DECCW at the University of Western Sydney (UWS), Richmond Campus, approximately 12 km west-southwest of the site. These data have been used as representative meteorological data for the site. Windroses have been created from the DECCW monitoring site and are shown in **Figure 4**.

The windroses show that on an annual basis winds are predominantly from the east-northeast and south-southwest, with a smaller portion of winds from the west and southwest. In summer winds are most frequently from the east-northeast and east. In autumn and spring the wind is mainly from the east-northeast and south-southwest and follows a similar distribution to the annual windrose. In winter the dominate wind directions are from the south-southwest and west.

Calm wind speeds of less than 0.5 m/s were present 21.8% of the time, on an annual basis. The annual average windspeed is 1.66 m/s.

Figure 3: Annual and seasonal windroses for Richmond RAAF BoM, 2007

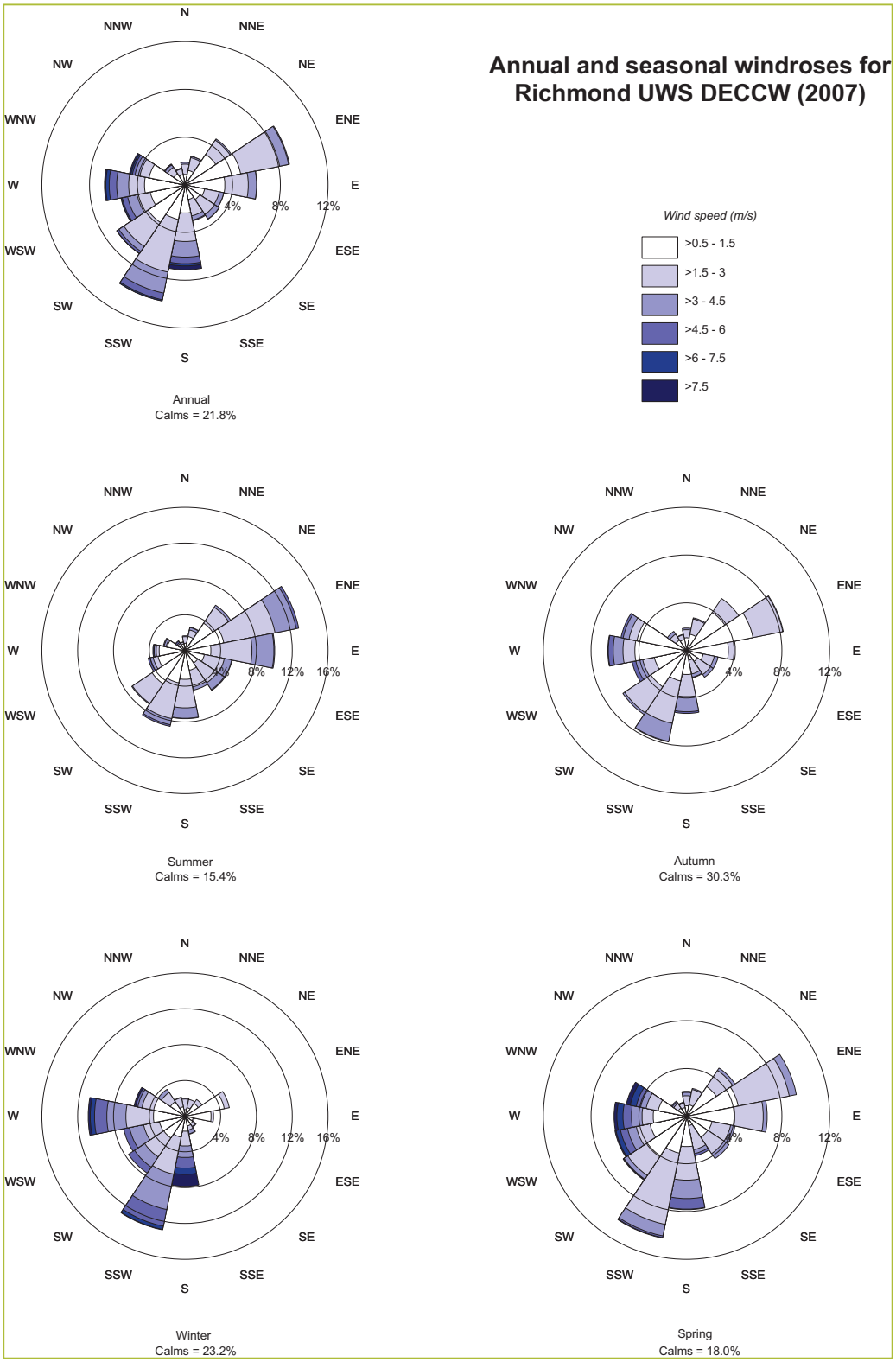


Figure 4: Annual and seasonal windroses for Richmond UWS DECCW, 2007

4.2 Atmospheric stability

To use the wind data to assess dispersion it is necessary to also have available data on atmospheric stability[a]. **Table 4.1** shows the frequency of occurrence of the stability categories calculated using the sigma theta data. The most common stability occurrences were calculated to be F class stability (30.3%) which suggests that emissions will disperse poorly for a significant proportion of the time.

Joint wind speed, wind direction and stability class frequency tables generated from the Richmond data are presented in **Appendix B**.

Table 4.1: Frequency of occurrence of stability classes at Richmond (2007)

Stability Class	2007
A	22.0
B	6.3
C	8.4
D	21.8
E	11.3
F	30.3
Total	**100**

4.3 Climatic Conditions

The Bureau of Meteorology (BoM) collects climatic information in the vicinity of the study area. A range of climatic information collected from the Richmond RAAF (located approximately 7 km west-southwest from the Project site) is presented in **Table 4.2** (**Bureau of Meteorology, 2010**). Temperature and humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean and median monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures experienced at Richmond RAAF are 23.7°C and 11°C respectively. On average January is the hottest month with an average maximum temperature of 29.6°C. July is the coldest month, with average minimum temperature of 3.6°C.

The annual average relative humidity reading collected at 9 am from the Richmond RAAF site is 75% and at 3 pm the annual average is 49%. The month with the highest relative humidity on average is June with a 9 am average of 84%. The month with the lowest relative humidity is September with a 3 pm average of 42%.

Rainfall data collected at Richmond RAAF shows that February is the wettest month with an average rainfall of 105.6 mm over 7.5 days. The average annual rainfall is 809.3 mm with an average of 71.5 raindays.

[a] In dispersion modelling atmospheric stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford-Turner stability class assignment scheme there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

Table 4.2: Temperature, Humidity and Rainfall for Richmond RAAF BoM Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Daily Maximum Temperature (°C)													
Mean	29.6	28.6	27.0	23.9	20.3	17.6	17.2	18.8	21.5	24.5	26.8	28.8	23.7
Daily Minimum Temperature (°C)													
Mean	17.4	17.4	15.5	11.8	7.9	5.1	3.6	5.0	7.4	11.0	13.7	15.9	11.0
9am Mean Temperature (°C) and Relative Humidity (%)													
Dry-bulb	22.0	21.3	20.1	16.6	12.3	9.3	8.0	10.5	14.1	17.7	19.5	21.4	16.1
Humidity	74	79	77	79	83	84	82	75	68	65	66	68	75
3pm Mean Temperature (°C) and Relative Humidity (%)													
Dry-bulb	28.2	27.3	25.9	23.0	19.6	16.9	16.4	17.8	20.4	23.1	25.2	26.9	22.6
Humidity	50	54	52	53	54	55	49	45	42	45	45	48	49
Rainfall (mm)													
Monthly mean	93.3	105.6	92.1	70.3	58.8	56.4	35.9	45.8	39.5	64.1	76.1	71.7	809.3
Raindays (Number)													
Mean no. of raindays	7.3	7.5	7.4	6.0	5.3	4.9	4.0	4.6	4.9	6.1	7.0	6.5	71.5

Station number: 067033; Commenced 1928; Last record October 1994; Elevation: 19m AHD; Latitude: 33.60; Longitude: 150.78

Source: **Bureau of Meteorology (2010).**

5 ESTIMATE OF AIR EMISSIONS

5.1 Odour emissions

In August 2008, The Odour Unit Pty Ltd collected odour samples from an existing recycled water facility at Pennant Hills Golf Course and analysed them using odour panellists in accordance with the Australian Standard described **Section 3.1**. The full results are included in **Appendix C**.

A downwind composite odour sample was taken across the face of the screens within one metre of the source with a 'temporary hood' (tarpaulin) set-up on top of the screens in an attempt to confine the air flowing across the screens and to reduce the turbulence. The odour from this location was described by the odour panellists as "sulfide" and "sewage". An upwind sample was also taken, with this sample being described as "grassy" by the odour panellists.

Modelling of fugitive sources is challenging as it is not possible to accurately measure the flow of air from the source. While the screens themselves are an area source, the odour emissions escape via what are effectively three point sources. To calculate the odour emission rate, it was assumed the exit velocity of air is a nominal 0.5 m/s and the diameter of the exit points taken to be 0.11 m and 0.08 m.

Table 5.1 presents a summary of the data used in the modelling.

Table 5.1: Measured odour emissions – Pennant Hills Golf Course, Recycled Water Facility

Source	Odour concentration (ou)	Exit Velocity (m/s)	Diameter (m)	Area (m^2)	Odour emission rate[a] ($ou.m^3/s$)
Point 1	856	0.5	0.11	0.010	4.1
Point 2	856	0.5	0.08	0.005	2.2
Point 3	856	0.5	0.08	0.005	2.2
				Total odour emissions	**8.5**

a) Odour emission rate = odour concentration (ou) * exit velocity (m/s) * area (m^2)

The total odour emission rate (8.5 $ou.m^3/s$) was emitted from a screen with an area of approximately two square metres. Therefore, the odour emission rate can also be expressed as 4.25 $ou.m^3/s/m^2$ [8.5 ($ou.m^3/s$) / 2 (m^2)]. This is similar to odour emission rates measured at the inlet of sewage treatment plants, which would effectively be receiving the same material as the RWF (see **Table 5.2**).

Table 5.2: Specific odour emission rates from sewage treatment plants

Source	Odour emission rate ($ou.m^3/s/m^2$)
Liverpool STP – inlet	1.9
Rosedale STP – inlet works	4.3
Cronulla STP – primary sedimentation tanks inlet	4.5

As the sample at Pennant Hills Golf Course was taken as a composite at a distance of approximately one metre from the screen, the odour concentration would have been diluted to some degree, compared with the odour concentration directly at the face of the screens. Therefore, in order to test the sensitivity of the model, an additional scenario (Scenario 2) was modelled with the odour emission rates multiplied by a factor of 5. **Table 5.3** presents a summary of the modelled emission rates used, including the application of the peak-to-mean values.

Peak-to-mean factors of 4 (for stability classes A-C), and 7 (for stability classes D to F) were used, consistent with a surface wake-free point. It was also assumed that the temperature of the emission was at 20°C.

Table 5.3: Modelled odour emission rates

Source	Odour emission rate ($ou.m^3/s/m^2$)[a]	Modelled odour emission rate ($ou.m^3/s$)	
		Stability class A to C Peak-to-mean = 4	Stability class D to F Peak-to-mean = 7
Scenario1			
Point 1	20.3	16.3	28.5
Point 2	10.8	8.6	15.1
Point 3	10.8	8.6	15.1
Scenario 2			
Point 1	20.3	81.3	142.4
Point 2	10.8	43.0	75.3
Point 3	10.8	43.0	75.3

a) Some values may not be exact due to rounding

6 APPROACH TO ASSESSMENT

Potential impacts have been assessed using AUSPLUME Version 6. Account has been taken of local dispersion conditions and estimated emissions from the facility. AUSPLUME is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (**VEPA, 1986**) and is based on the United States Environmental Protection Agency's Industrial Source Complex (ISC) model. It has recently been upgraded with a graphical user interface and other features. It is widely used throughout Australia and is regarded as a "state-of-the-art" model. AUSPLUME has been used extensively for assessing odour impacts and is the recommended model in the NSW DECCW guidelines for air quality impact assessments (**NSW DEC, 2005**).

The way in which the model has been used in this study has been to predict the 1-hour average odour levels (expressed in odour units) at a set of receptors at 50 m spacing arranged over the modelling domain. In addition, a number of discrete receptors were selected at the nearby residences and possible future residences, as shown on **Figure 1**.

Meteorological data from Richmond DECCW monitoring site as described in **Section 4** were used in conjunction with the emissions data discussed in **Table 5.3**. **Table 6.1** summarises the modelling parameters used in this assessment.

Table 6.1: Source parameters and emission rates used for odour modelling

Modelling parameters	Source ID		
	Point 1	Point 2	Point 3
Source location (MGA) (easting, northing, m)	302077 6282351	302076.5 6282351	302077.5 6282351
Stack height (m)	4.5	4.5	4.5
Stack diameter (m)	0.11	0.08	0.08
Temperature (°C)	20	20	20
Exit velocity (m/s)	0.5	0.5	0.5

a) Some values may not be exact due to rounding

For the purposes of presenting the results, all predicted odour levels at each receptor have been retained by the model and a contour plot has been prepared showing the distribution of the 99th percentile 1-hour levels at ground-level. The 99th percentile levels are plotted as the impact assessment criteria are set to ensure that the predicted odour level is not exceed more than 1% of the year.

An example output from the modelling file is shown in **Appendix D**.

7 RESULTS AND DISCUSSION

Figure 5 presents the predicted 99th percentile odour levels at ground-level using the emission rate calculated from the measured data. **Figure 6** shows the predicted odour levels with an emission rate five times the measured value. It is important to note when inspecting these figures, that the odour impact assessment criteria is 2 ou. Any levels equal to or less than 2 ou are in compliance with the criteria. An odour level of 1 ou or less at a receiver would not be considered offensive and generally not be noticed by the average person. Levels of 1 ou or less have been shown on the figures for information purposes only.

The maximum predicted impacts (at the 99th percentile) are a short distance from the source as the emissions are located at a height of 4.5 m above ground-level, whereas the plot shows the

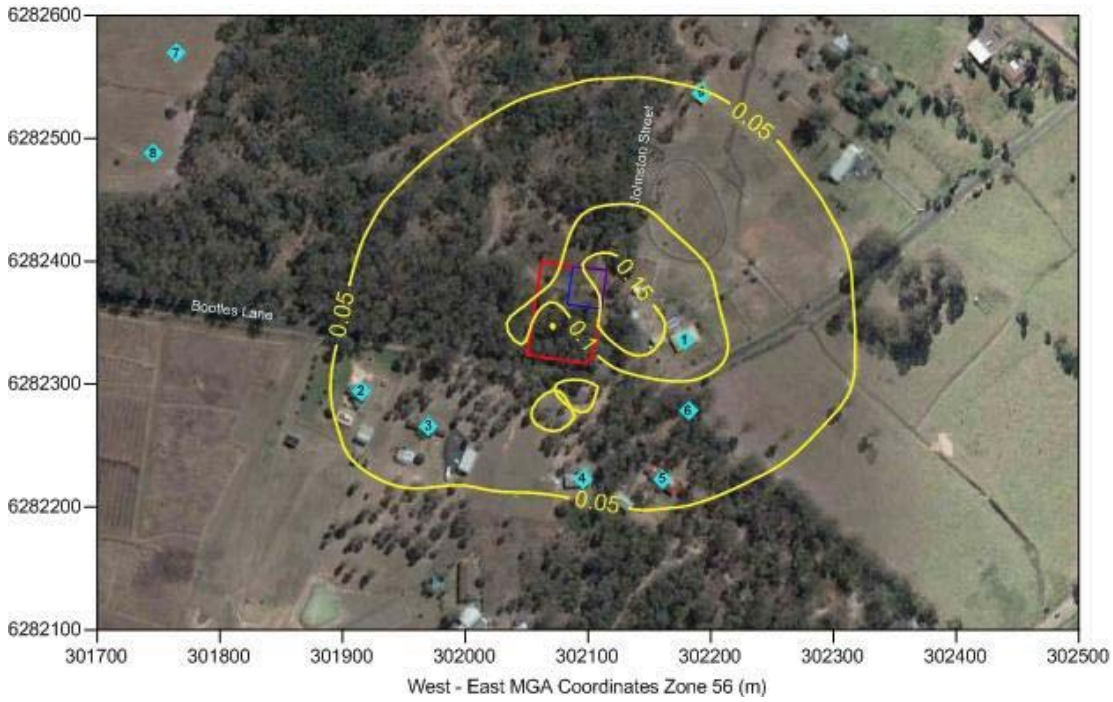
predicted impacts at ground-level. The plot therefore shows the location where the plume hits the ground.

Table 7.1 shows the predicted impacts at the nearby residences for both scenarios. As noted above, odour concentrations of 1 ou or less would generally not be noticed. In a residential area, such as Pitt Town and the residential subdivisions associated with the Pitt Town Master Plan, the assessment criteria allow an odour level of up to 2 ou.

It can be seen that using the measured emissions data (Scenario 1), the predicted impacts at all the off-site receptors are below 1 ou. Even with the emissions data at a rate of five times that measured (Scenario 2), the predicted odour levels are shown to comply with the 2 odour unit goal at all locations.

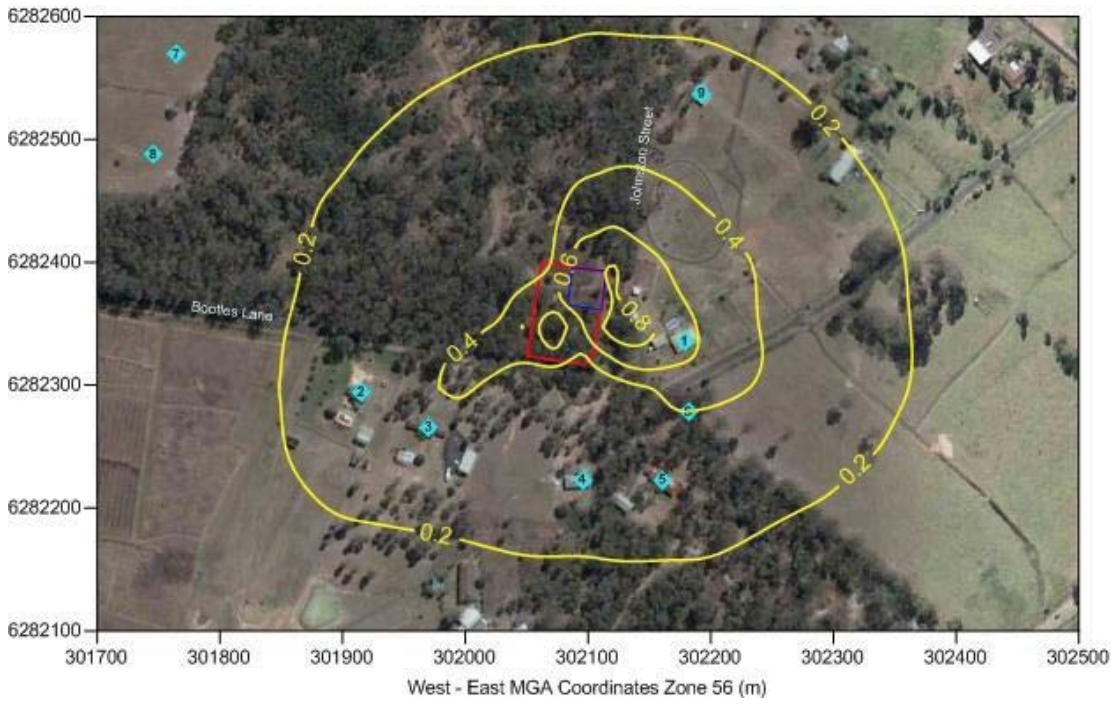
Table 7.1: Predicted 99th percentile predicted ground level odour concentration at the discrete receptors (ou)

Residence ID	MGA coordinates		Predicted 99th percentile ground level odour concentration (ou)	
	Easting (m)	Northing (m)	Scenario 1	Scenario 2
1	302179	6282336	0.1	0.7
2	301916	6282294	0.1	0.3
3	301971	6282266	0.1	0.4
4	302096	6282223	0.1	0.3
5	302161	6282223	0.1	0.3
6	302182	6282278	0.1	0.4
7	301765	6282569	0.0	0.1
8	301746	6282488	0.0	0.1
9	302193	6282537	0.1	0.3



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Odour	Pitt Town	Scenario 1	99th	1-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AUSPLUME V6	ou	DECCW = 2 ou	Richmond, 2007	P Henschke

Figure 5: 99th percentile 1-hour average odour contours, Scenario 1 – measured emission data



Species: Odour	**Location:** Pitt Town	**Scenario:** Scenario 2	**Percentile:** 99th	**Averaging Time:** 1-Hour
Model Used: AUSPLUME V6	**Units:** ou	**Guideline:** DECCW = 2 ou	**Met Data:** Richmond, 2007	**Plot:** P Henschke

Figure 6: 99th percentile 1-hour average odour contours, Scenario 2 – five times measured emission data

8 CONCLUSIONS

This study has assessed the air quality impacts associated with the proposed Recycled Water Factory at a location at Pitt Town, NSW. An assessment of odour, based on odour emissions data collected at a similar facility, combined with local meteorological data and computer-based dispersion modelling, was used to determine the air quality impacts on residential areas in the vicinity of the plant.

Results from the dispersion modelling indicated that ground-level odour concentrations from the proposed facility are unlikely to exceed 1 ou at the residences. An odour concentration of 1 ou or less would not be considered a nuisance and generally, would not be noticed. In a residential area, such as Pitt Town, the assessment criterion allows an odour level of up to 2 ou. As a sensitivity test (Scenario 2), using five times the measured emissions data, the computer modelling has demonstrated it is unlikely this level would be reached off-site.

9 REFERENCES

Bureau of Meteorology (2010)
Climatic Averages Australia, Bureau of Meteorology website, www.bom.gov.au.

CEN (1996)
"Document 064/e – Draft European Standard – Odour Concentration Measurement by Dynamic Olfactometry" CEN TC264/WG2 'Odours' Final WG2 Draft prEN", Committé Européen de Normalisation,Brussels.

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".

NSW DEC (2005)
"Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW", August 2005

Standards Australia (2001)
"Stationary source emissions - Part 3: Determination of odour concentration by dynamic olfactometry" First published as AS/NZS 4323.3:2001. Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020.

VEPA (1986)
"The Ausplume Gaussian Plume Dispersion Model", Environment Protection Authority, Olderfleet Buildings, 477 Collins Street, Melbourne Victoria 3000, Publication Number 264.

APPENDIX A: Peak-to-Mean Ratios

The following table shows recommended factors for estimating peak concentrations for different source types, stabilities and distances.

Table 9.1: Factors for estimating peak concentration in flat terrain

Source Type	Pasquill-Gifford stability class	Near field P/M60*	Far field P/M60
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A – F	6	6
Surface point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A – F	2.3	2.3
Volume	A – F	2.3	2.3

*Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

APPENDIX B: Joint wind speed, wind direction and stability class frequency tables

STATISTICS FOR FILE: C:\Jobs\3840_Pitt_Town_RWF\richmd07.aus
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.006732	0.004410	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011142
NE	0.017061	0.006035	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.023097
ENE	0.025070	0.012999	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.038069
E	0.021240	0.006616	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.027855
ESE	0.009517	0.002321	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011838
SE	0.005919	0.002437	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008357
SSE	0.004759	0.002786	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007544
S	0.007776	0.003018	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010794
SSW	0.004643	0.002089	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006732
SW	0.003830	0.001393	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005223
WSW	0.002089	0.000929	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003018
W	0.002669	0.000812	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003482
WNW	0.002669	0.001161	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003830
NW	0.001857	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002089
NNW	0.002669	0.000812	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003482
N	0.003482	0.002669	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006151
CALM									0.047470
TOTAL	0.121982	0.050720	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.220172

MEAN WIND SPEED (m/s) = 1.12
NUMBER OF OBSERVATIONS = 1897

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000464	0.002437	0.000580	0.000000	0.000000	0.000000	0.000000	0.000000	0.003482
NE	0.001161	0.003018	0.000696	0.000000	0.000000	0.000000	0.000000	0.000000	0.004875
ENE	0.004526	0.006848	0.001277	0.000000	0.000000	0.000000	0.000000	0.000000	0.012651
E	0.001625	0.002437	0.001045	0.000000	0.000000	0.000000	0.000000	0.000000	0.005107
ESE	0.000812	0.002669	0.000812	0.000000	0.000000	0.000000	0.000000	0.000000	0.004294
SE	0.000696	0.002553	0.000929	0.000000	0.000000	0.000000	0.000000	0.000000	0.004178
SSE	0.000696	0.002669	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.003714
S	0.001857	0.003946	0.000580	0.000000	0.000000	0.000000	0.000000	0.000000	0.006383
SSW	0.001161	0.001973	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.003366
SW	0.001277	0.001161	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.002669
WSW	0.000232	0.000580	0.000812	0.000000	0.000000	0.000000	0.000000	0.000000	0.001625
W	0.001277	0.000696	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.002205
WNW	0.000464	0.001045	0.000580	0.000000	0.000000	0.000000	0.000000	0.000000	0.002089
NW	0.000116	0.000580	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.001045
NNW	0.000116	0.000696	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.001045
N	0.000696	0.001625	0.000696	0.000000	0.000000	0.000000	0.000000	0.000000	0.003018
CALM									0.000929
TOTAL	0.017177	0.034935	0.009633	0.000000	0.000000	0.000000	0.000000	0.000000	0.062674

MEAN WIND SPEED (m/s) = 2.10
NUMBER OF OBSERVATIONS = 540

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000232	0.000812	0.000232	0.000116	0.000000	0.000000	0.000000	0.000000	0.001393
NE	0.000348	0.001161	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.001741
ENE	0.000929	0.003018	0.004875	0.000580	0.000000	0.000000	0.000000	0.000000	0.009401
E	0.000696	0.003250	0.004526	0.000232	0.000000	0.000000	0.000000	0.000000	0.008705
ESE	0.000348	0.002902	0.002786	0.000116	0.000000	0.000000	0.000000	0.000000	0.006151
SE	0.000232	0.003830	0.002437	0.000232	0.000000	0.000000	0.000000	0.000000	0.006732
SSE	0.000232	0.003134	0.002437	0.000348	0.000000	0.000000	0.000000	0.000000	0.006151
S	0.000696	0.005223	0.004410	0.002321	0.000000	0.000000	0.000000	0.000000	0.012651
SSW	0.001045	0.003250	0.001741	0.000348	0.000000	0.000000	0.000000	0.000000	0.006383
SW	0.001161	0.001161	0.000696	0.000812	0.000000	0.000000	0.000000	0.000000	0.003830
WSW	0.000696	0.000696	0.001973	0.001973	0.000000	0.000000	0.000000	0.000000	0.005339
W	0.001277	0.000929	0.003018	0.001277	0.000000	0.000000	0.000000	0.000000	0.006500
WNW	0.000812	0.000812	0.000929	0.001045	0.000000	0.000000	0.000000	0.000000	0.003598
NW	0.000000	0.000696	0.001045	0.000696	0.000000	0.000000	0.000000	0.000000	0.002437
NNW	0.000116	0.000696	0.000232	0.000116	0.000000	0.000000	0.000000	0.000000	0.001161
N	0.000116	0.000348	0.000348	0.000232	0.000000	0.000000	0.000000	0.000000	0.001045
CALM									0.000348
TOTAL	0.008937	0.031917	0.031917	0.010446	0.000000	0.000000	0.000000	0.000000	0.083565

MEAN WIND SPEED (m/s) = 3.10
NUMBER OF OBSERVATIONS = 720

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000812	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.001161
NE	0.001161	0.000929	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.002437
ENE	0.002786	0.004643	0.001509	0.000116	0.000000	0.000000	0.000000	0.000000	0.009053
E	0.001973	0.003134	0.001393	0.000000	0.000000	0.000000	0.000000	0.000000	0.006500
ESE	0.000464	0.001741	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.002437
SE	0.000348	0.002321	0.001161	0.000000	0.000000	0.000000	0.000000	0.000000	0.003830
SSE	0.000232	0.002437	0.000696	0.000348	0.000000	0.000000	0.000000	0.000000	0.003714
S	0.001625	0.006616	0.007892	0.003250	0.001857	0.001509	0.001045	0.000696	0.024489
SSW	0.006035	0.030060	0.015204	0.005223	0.001045	0.000116	0.000000	0.000000	0.057683
SW	0.008124	0.014508	0.003830	0.001161	0.000116	0.000116	0.000000	0.000000	0.027855
WSW	0.007312	0.006151	0.005107	0.002553	0.000929	0.000232	0.000000	0.000000	0.022284
W	0.008937	0.007312	0.006616	0.004991	0.002786	0.000929	0.000232	0.000000	0.031801
WNW	0.009053	0.002902	0.002437	0.001161	0.001277	0.000929	0.000232	0.000116	0.018106
NW	0.000464	0.001277	0.001045	0.000000	0.000116	0.000000	0.000000	0.000000	0.002902
NNW	0.000116	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000464
N	0.000116	0.001161	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.001625
CALM									0.001161
TOTAL	0.048747	0.086351	0.048166	0.018802	0.008124	0.003830	0.001509	0.000812	0.217502

MEAN WIND SPEED (m/s) = 2.95
NUMBER OF OBSERVATIONS = 1874

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000812	0.001045	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001857
NE	0.003598	0.001625	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005223
ENE	0.004294	0.005107	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009401
E	0.002669	0.003134	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005803
ESE	0.002321	0.002321	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004643
SE	0.002553	0.002786	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005339
SSE	0.002089	0.002669	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004759
S	0.004178	0.003482	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.007892
SSW	0.005687	0.006848	0.000812	0.000000	0.000000	0.000000	0.000000	0.000000	0.013347
SW	0.008240	0.003830	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.012303
WSW	0.007776	0.001741	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.009749
W	0.006732	0.001973	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.008937
WNW	0.006383	0.001277	0.000232	0.000000	0.000000	0.000000	0.000000	0.000000	0.007892
NW	0.002321	0.001625	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003946
NNW	0.001161	0.000929	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002089
N	0.000696	0.001393	0.000116	0.000000	0.000000	0.000000	0.000000	0.000000	0.002205
CALM									0.007776
TOTAL	0.061513	0.041783	0.002089	0.000000	0.000000	0.000000	0.000000	0.000000	0.113162

MEAN WIND SPEED (m/s) = 1.39
NUMBER OF OBSERVATIONS = 975

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.004294	0.001277	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005571
NE	0.007544	0.001509	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009053
ENE	0.009749	0.000696	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010446
E	0.004991	0.001045	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006035
ESE	0.003134	0.000464	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003598
SE	0.004875	0.001045	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005919
SSE	0.004294	0.000348	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004643
S	0.007312	0.001509	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008821
SSW	0.010794	0.000696	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011490
SW	0.014972	0.002205	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.017177
WSW	0.011722	0.001161	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012883
W	0.013231	0.001509	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014740
WNW	0.011490	0.000696	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012187
NW	0.006732	0.001973	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008705
NNW	0.004759	0.001509	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006267
N	0.003830	0.001393	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005223
CALM									0.160167
TOTAL	0.123723	0.019034	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.302925

MEAN WIND SPEED (m/s) = 0.74
NUMBER OF OBSERVATIONS = 2610

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.012535	0.010794	0.001161	0.000116	0.000000	0.000000	0.000000	0.000000	0.024605
NE	0.030873	0.014276	0.001277	0.000000	0.000000	0.000000	0.000000	0.000000	0.046425
ENE	0.047354	0.033310	0.007660	0.000696	0.000000	0.000000	0.000000	0.000000	0.089020
E	0.033194	0.019615	0.006964	0.000232	0.000000	0.000000	0.000000	0.000000	0.060005
ESE	0.016597	0.012419	0.003830	0.000116	0.000000	0.000000	0.000000	0.000000	0.032962
SE	0.014624	0.014972	0.004526	0.000232	0.000000	0.000000	0.000000	0.000000	0.034355
SSE	0.012303	0.014044	0.003482	0.000696	0.000000	0.000000	0.000000	0.000000	0.030525
S	0.023445	0.023793	0.013115	0.005571	0.001857	0.001509	0.001045	0.000696	0.071031
SSW	0.029364	0.044916	0.017990	0.005571	0.001045	0.000116	0.000000	0.000000	0.099002
SW	0.037604	0.024257	0.004991	0.001973	0.000116	0.000116	0.000000	0.000000	0.069058
WSW	0.029828	0.011258	0.008124	0.004526	0.000929	0.000232	0.000000	0.000000	0.054898
W	0.034123	0.013231	0.010097	0.006267	0.002786	0.000929	0.000232	0.000000	0.067665
WNW	0.030873	0.007892	0.004178	0.002205	0.001277	0.000929	0.000232	0.000116	0.047702
NW	0.011490	0.006383	0.002437	0.000696	0.000116	0.000000	0.000000	0.000000	0.021123
NNW	0.008937	0.004991	0.000464	0.000116	0.000000	0.000000	0.000000	0.000000	0.014508
N	0.008937	0.008589	0.001509	0.000232	0.000000	0.000000	0.000000	0.000000	0.019266
CALM									0.217851
TOTAL	0.382080	0.264740	0.091806	0.029248	0.008124	0.003830	0.001509	0.000812	1.000000

MEAN WIND SPEED (m/s) = 1.66
NUMBER OF OBSERVATIONS = 8616

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 22.0%
B : 6.3%
C : 8.4%
D : 21.8%
E : 11.3%
F : 30.3%

APPENDIX C: Odour measurements from Pennant Hills Golf Course

THE ODOUR UNIT
Screens Odour Emission Rate
Calculation Sheet

Client: Holmes Air Sciences
Sampling Site: Pennant Hills Golf Club
Project Number: N1422.01L

Sample Location	Est. Plume Width (m)	Est. Plume Height (m)	Plume cross-sectional area (m^2)	Avg. Wind Speed (m/s)	Avg. Volumetric Flow Rate (m^3/s)	Odour Concentration (ou) (Difference of upwind & downwind)	Est. OER ($ou.m^3/s$)
Screens	2.0	1.6	3.2	0.85	2.7	856	2,300

Note- The plume width and height were defined by the dimensions of the screen. The average wind speed was measured across the screen profile.

Each sample collected was a composite across the screen cross-sectional profile. OER calculations are to 2 significant figures.

APPENDIX D: Output from AUSPLUME model

1 _____

Pitt Town

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Concentration or deposition	Concentration
Emission rate units	OUV/second
Concentration units	Odour_Units
Units conversion factor	1.00E+00
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	Yes
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Averaging time for sigma-theta values	60 min.

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Sigma-theta
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.100m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

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1 _____

Pitt Town

SOURCE CHARACTERISTICS

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STACK SOURCE: 1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
302077	6282351	0m	5m	0.11m	20C	0.5m/s

No building wake effects.

Emission rates by stability and wind speed, in OUV/second:

```
Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01
   Stability B:  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01
   Stability C:  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01  1.63E+01
   Stability D:  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01
   Stability E:  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01
   Stability F:  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01  2.85E+01

                 No gravitational settling or scavenging.


                  STACK SOURCE: 2

   X(m)     Y(m)   Ground Elev.  Stack Height  Diameter Temperature  Speed
 302077  6282351         0m            5m        0.08m       20C     0.5m/s

                       No building wake effects.

         Emission rates by stability and wind speed, in OUV/second:

Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability B:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability C:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability D:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01
   Stability E:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01
   Stability F:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01

                 No gravitational settling or scavenging.


                  STACK SOURCE: 3

   X(m)     Y(m)   Ground Elev.  Stack Height  Diameter Temperature  Speed
 302078  6282351         0m            5m        0.08m       20C     0.5m/s

                       No building wake effects.

         Emission rates by stability and wind speed, in OUV/second:

Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability B:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability C:  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00  8.60E+00
   Stability D:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01
   Stability E:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01
   Stability F:  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01  1.51E+01

                 No gravitational settling or scavenging.

_____________________________________________________________________________

1                          _____________________

                                Pitt Town

                           RECEPTOR LOCATIONS

                           _____________________

 The Cartesian receptor grid has the following x-values (or eastings):
 301700.m  301750.m  301800.m  301850.m  301900.m  301950.m  302000.m
 302050.m  302100.m  302150.m  302200.m  302250.m  302300.m  302350.m
 302400.m  302450.m  302500.m  302550.m  302600.m  302650.m  302700.m
 302750.m  302800.m  302850.m  302900.m  302950.m  303000.m  303050.m
 303100.m  303150.m  303200.m  303250.m  303300.m  303350.m  303400.m
 303450.m  303500.m  303550.m  303600.m  303650.m  303700.m  303750.m
 303800.m  303850.m  303900.m  303950.m  304000.m  304050.m  304100.m
 304150.m

 and these y-values (or northings):
6282100.m 6282150.m 6282200.m 6282250.m 6282300.m 6282350.m 6282400.m
6282450.m 6282500.m 6282550.m 6282600.m 6282650.m 6282700.m 6282750.m
6282800.m 6282850.m 6282900.m 6282950.m 6283000.m 6283050.m 6283100.m
6283150.m 6283200.m 6283250.m 6283300.m 6283350.m 6283400.m 6283450.m
6283500.m 6283550.m 6283600.m 6283650.m 6283700.m 6283750.m 6283800.m
6283850.m 6283900.m 6283950.m 6284000.m 6284050.m 6284100.m 6284150.m
6284200.m 6284250.m 6284300.m 6284350.m 6284400.m 6284450.m 6284500.m
6284550.m
```

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	302047	6282349	0.0	0.0	101	302245	6282265	0.0	0.0
2	302047	6282372	0.0	0.0	102	302196	6282204	0.0	0.0
3	302053	6282388	0.0	0.0	103	302124	6282171	0.0	0.0
4	302056	6282406	0.0	0.0	104	302059	6282174	0.0	0.0
5	302073	6282405	0.0	0.0	105	301951	6282187	0.0	0.0
6	302087	6282405	0.0	0.0	106	301927	6282196	0.0	0.0
7	302105	6282403	0.0	0.0	107	301877	6282247	0.0	0.0
8	302125	6282392	0.0	0.0	108	301855	6282311	0.0	0.0
9	302126	6282378	0.0	0.0	109	301857	6282375	0.0	0.0
10	302124	6282364	0.0	0.0	110	301895	6282476	0.0	0.0
11	302125	6282346	0.0	0.0	111	301902	6282504	0.0	0.0
12	302121	6282333	0.0	0.0	112	301962	6282534	0.0	0.0
13	302108	6282311	0.0	0.0	113	302003	6282561	0.0	0.0
14	302082	6282305	0.0	0.0	114	302068	6282561	0.0	0.0
15	302059	6282311	0.0	0.0	115	302146	6282567	0.0	0.0
16	302044	6282323	0.0	0.0	116	302233	6282567	0.0	0.0
17	302045	6282336	0.0	0.0	117	302291	6282512	0.0	0.0
18	302049	6282303	0.0	0.0	118	302352	6282411	0.0	0.0
19	302034	6282324	0.0	0.0	119	302355	6282333	0.0	0.0
20	302035	6282339	0.0	0.0	120	302339	6282249	0.0	0.0
21	302037	6282366	0.0	0.0	121	302319	6282191	0.0	0.0
22	302039	6282391	0.0	0.0	122	302271	6282160	0.0	0.0
23	302045	6282408	0.0	0.0	123	302200	6282136	0.0	0.0
24	302062	6282419	0.0	0.0	124	302142	6282135	0.0	0.0
25	302087	6282418	0.0	0.0	125	302043	6282134	0.0	0.0
26	302106	6282417	0.0	0.0	126	301976	6282133	0.0	0.0
27	302128	6282408	0.0	0.0	127	301913	6282135	0.0	0.0
28	302135	6282392	0.0	0.0	128	301830	6282158	0.0	0.0
29	302139	6282377	0.0	0.0	129	301796	6282196	0.0	0.0
30	302139	6282361	0.0	0.0	130	301796	6282287	0.0	0.0
31	302138	6282347	0.0	0.0	131	301785	6282357	0.0	0.0
32	302129	6282326	0.0	0.0	132	301792	6282411	0.0	0.0
33	302125	6282310	0.0	0.0	133	301807	6282482	0.0	0.0
34	302117	6282297	0.0	0.0	134	301848	6282539	0.0	0.0
35	302105	6282292	0.0	0.0	135	301880	6282570	0.0	0.0
36	302084	6282288	0.0	0.0	136	301916	6282407	0.0	0.0
37	302068	6282288	0.0	0.0	137	301924	6282360	0.0	0.0
38	302044	6282292	0.0	0.0	138	301924	6282300	0.0	0.0
39	302026	6282300	0.0	0.0	139	301944	6282246	0.0	0.0
40	302018	6282318	0.0	0.0	140	301998	6282219	0.0	0.0
41	302013	6282334	0.0	0.0	141	302026	6282216	0.0	0.0
42	302015	6282354	0.0	0.0	142	302247	6282403	0.0	0.0
43	302013	6282375	0.0	0.0	143	302254	6282482	0.0	0.0
44	302016	6282393	0.0	0.0	144	302334	6282555	0.0	0.0
45	302026	6282412	0.0	0.0	145	302330	6282488	0.0	0.0
46	302036	6282422	0.0	0.0	146	302407	6282482	0.0	0.0
47	302064	6282433	0.0	0.0	147	302388	6282349	0.0	0.0
48	302082	6282433	0.0	0.0	148	302387	6282304	0.0	0.0
49	302103	6282430	0.0	0.0	149	302385	6282216	0.0	0.0
50	302124	6282420	0.0	0.0	150	302371	6282156	0.0	0.0
51	302141	6282411	0.0	0.0	151	301776	6282129	0.0	0.0
52	302153	6282399	0.0	0.0	152	301762	6282165	0.0	0.0
53	302154	6282376	0.0	0.0	153	301745	6282241	0.0	0.0
54	302154	6282360	0.0	0.0	154	301735	6282306	0.0	0.0
55	302145	6282326	0.0	0.0	155	301740	6282397	0.0	0.0
56	302137	6282311	0.0	0.0	156	301747	6282455	0.0	0.0
57	302121	6282278	0.0	0.0	157	302446	6282396	0.0	0.0
58	302091	6282274	0.0	0.0	158	302460	6282273	0.0	0.0
59	302071	6282272	0.0	0.0	159	302447	6282214	0.0	0.0
60	302048	6282272	0.0	0.0	160	302441	6282171	0.0	0.0
61	302021	6282282	0.0	0.0	161	302061	6282212	0.0	0.0
62	302009	6282290	0.0	0.0	162	302059	6282333	0.0	0.0
63	301996	6282310	0.0	0.0	163	302066	6282348	0.0	0.0
64	301991	6282336	0.0	0.0	164	302067	6282363	0.0	0.0
65	301991	6282368	0.0	0.0	165	302070	6282381	0.0	0.0
66	301993	6282390	0.0	0.0	166	302083	6282389	0.0	0.0
67	302018	6282419	0.0	0.0	167	302099	6282388	0.0	0.0
68	302031	6282436	0.0	0.0	168	302100	6282376	0.0	0.0
69	302044	6282447	0.0	0.0	169	302087	6282375	0.0	0.0
70	302077	6282452	0.0	0.0	170	302087	6282362	0.0	0.0
71	302121	6282445	0.0	0.0	171	302097	6282363	0.0	0.0
72	302141	6282436	0.0	0.0	172	302101	6282352	0.0	0.0
73	302154	6282427	0.0	0.0	173	302094	6282345	0.0	0.0
74	302173	6282397	0.0	0.0	174	302093	6282334	0.0	0.0
75	302178	6282385	0.0	0.0	175	302098	6282326	0.0	0.0
76	302171	6282361	0.0	0.0	176	302080	6282324	0.0	0.0
77	302170	6282352	0.0	0.0	177	302066	6282329	0.0	0.0

78	302160	6282330	0.0	0.0	178	302074	6282338	0.0	0.0
79	302162	6282319	0.0	0.0	179	302080	6282342	0.0	0.0
80	302165	6282299	0.0	0.0	180	302080	6282357	0.0	0.0
81	302155	6282287	0.0	0.0	181	302072	6282369	0.0	0.0
82	302139	6282273	0.0	0.0	182	302078	6282377	0.0	0.0
83	302153	6282310	0.0	0.0	183	302075	6282390	0.0	0.0
84	302141	6282298	0.0	0.0	184	302088	6282330	0.0	0.0
85	302138	6282291	0.0	0.0	185	302102	6282344	0.0	0.0
86	302122	6282264	0.0	0.0	186	302106	6282374	0.0	0.0
87	302100	6282261	0.0	0.0	187	302106	6282391	0.0	0.0
88	302087	6282258	0.0	0.0	188	302191	6282427	0.0	0.0
89	302048	6282255	0.0	0.0	189	302206	6282378	0.0	0.0
90	302038	6282257	0.0	0.0	190	302218	6282318	0.0	0.0
91	302007	6282272	0.0	0.0	191	302214	6282264	0.0	0.0
92	301990	6282286	0.0	0.0	192	302179	6282336	0.0	0.0
93	301976	6282301	0.0	0.0	193	301916	6282294	0.0	0.0
94	301954	6282403	0.0	0.0	194	301971	6282266	0.0	0.0
95	301959	6282437	0.0	0.0	195	302096	6282223	0.0	0.0
96	302001	6282490	0.0	0.0	196	302161	6282223	0.0	0.0
97	302124	6282510	0.0	0.0	197	302182	6282278	0.0	0.0
98	302208	6282470	0.0	0.0	198	301765	6282569	0.0	0.0
99	302280	6282411	0.0	0.0	199	301746	6282488	0.0	0.0
100	302273	6282334	0.0	0.0	200	302193	6282537	0.0	0.0

METEOROLOGICAL DATA : Meteorological file from Met MANAGER: CSV to AUSPLUM
E

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1 Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	5.14E-01	03,01/01/07	(302126, 6282378, 0.0)
2	5.06E-01	22,01/09/07	(302035, 6282339, 0.0)
3	4.86E-01	22,13/02/07	(302105, 6282403, 0.0)
4	4.74E-01	24,20/02/07	(302087, 6282405, 0.0)
5	4.68E-01	23,13/02/07	(302125, 6282346, 0.0)
6	4.53E-01	04,13/04/07	(302034, 6282324, 0.0)
7	4.51E-01	23,14/02/07	(302125, 6282346, 0.0)
8	4.50E-01	23,10/03/07	(302145, 6282326, 0.0)
9	4.48E-01	05,15/04/07	(302129, 6282326, 0.0)
10	4.46E-01	05,27/04/07	(302034, 6282324, 0.0)
11	4.44E-01	24,14/03/07	(302129, 6282326, 0.0)
12	4.42E-01	23,22/07/07	(302125, 6282346, 0.0)
13	4.38E-01	05,11/03/07	(302125, 6282346, 0.0)
14	4.32E-01	02,23/01/07	(302126, 6282378, 0.0)
15	4.20E-01	07,07/08/07	(302121, 6282333, 0.0)
16	4.20E-01	02,01/04/07	(302045, 6282336, 0.0)
17	4.17E-01	05,03/03/07	(302129, 6282326, 0.0)
18	4.17E-01	24,01/04/07	(302034, 6282324, 0.0)
19	4.15E-01	07,19/04/07	(302044, 6282323, 0.0)
20	4.14E-01	03,19/02/07	(302139, 6282361, 0.0)
21	4.14E-01	18,26/05/07	(302139, 6282361, 0.0)
22	4.12E-01	03,13/05/07	(302125, 6282346, 0.0)
23	4.11E-01	23,29/08/07	(302106, 6282374, 0.0)
24	4.10E-01	23,17/02/07	(302037, 6282366, 0.0)
25	4.08E-01	07,18/03/07	(302125, 6282346, 0.0)
26	4.07E-01	23,22/06/07	(302121, 6282333, 0.0)
27	4.04E-01	01,15/12/07	(302121, 6282333, 0.0)
28	4.02E-01	05,14/01/07	(302100, 6282400, 0.0)
29	4.00E-01	07,27/05/07	(302087, 6282405, 0.0)
30	3.98E-01	22,28/03/07	(302124, 6282364, 0.0)
31	3.93E-01	01,30/12/07	(302125, 6282346, 0.0)
32	3.93E-01	07,09/05/07	(302124, 6282364, 0.0)
33	3.92E-01	24,30/07/07	(302045, 6282336, 0.0)
34	3.92E-01	22,19/04/07	(302125, 6282346, 0.0)
35	3.90E-01	19,27/05/07	(302125, 6282346, 0.0)
36	3.90E-01	22,27/08/07	(302125, 6282346, 0.0)
37	3.84E-01	22,27/04/07	(302137, 6282311, 0.0)
38	3.82E-01	24,13/03/07	(302125, 6282346, 0.0)
39	3.80E-01	02,11/01/07	(302100, 6282376, 0.0)
40	3.80E-01	17,26/05/07	(302126, 6282378, 0.0)
41	3.77E-01	21,13/03/07	(302125, 6282392, 0.0)
42	3.77E-01	18,19/04/07	(302129, 6282326, 0.0)
43	3.77E-01	02,09/04/07	(302125, 6282346, 0.0)

44	3.77E-01	03,20/01/07	(302106, 6282391, 0.0)
45	3.76E-01	22,14/05/07	(302126, 6282378, 0.0)
46	3.75E-01	02,30/10/07	(302125, 6282346, 0.0)
47	3.72E-01	22,14/02/07	(302039, 6282391, 0.0)
48	3.71E-01	17,08/07/07	(302124, 6282364, 0.0)
49	3.71E-01	24,14/01/07	(302124, 6282364, 0.0)
50	3.71E-01	24,13/02/07	(302138, 6282347, 0.0)
51	3.71E-01	24,27/08/07	(302044, 6282323, 0.0)
52	3.71E-01	23,14/03/07	(302129, 6282326, 0.0)
53	3.70E-01	02,02/04/07	(302035, 6282339, 0.0)
54	3.70E-01	06,13/09/07	(302099, 6282388, 0.0)
55	3.70E-01	08,13/09/07	(302099, 6282388, 0.0)
56	3.65E-01	23,03/02/07	(302087, 6282405, 0.0)
57	3.65E-01	21,27/04/07	(302121, 6282333, 0.0)
58	3.65E-01	20,30/11/07	(301990, 6282286, 0.0)
59	3.64E-01	04,24/03/07	(302125, 6282346, 0.0)
60	3.64E-01	18,27/04/07	(302108, 6282311, 0.0)
61	3.63E-01	23,14/05/07	(302124, 6282364, 0.0)
62	3.63E-01	22,16/04/07	(302121, 6282333, 0.0)
63	3.61E-01	01,15/05/07	(302045, 6282336, 0.0)
64	3.60E-01	03,04/04/07	(302125, 6282392, 0.0)
65	3.59E-01	05,12/01/07	(302121, 6282333, 0.0)
66	3.55E-01	04,12/04/07	(302099, 6282388, 0.0)
67	3.54E-01	23,12/11/07	(302087, 6282405, 0.0)
68	3.53E-01	23,10/05/07	(302105, 6282403, 0.0)
69	3.52E-01	17,27/05/07	(302138, 6282347, 0.0)
70	3.51E-01	03,23/04/07	(302124, 6282364, 0.0)
71	3.51E-01	03,21/12/07	(302121, 6282333, 0.0)
72	3.50E-01	08,12/04/07	(302097, 6282363, 0.0)
73	3.48E-01	23,20/01/07	(302125, 6282392, 0.0)
74	3.47E-01	19,10/05/07	(302106, 6282391, 0.0)
75	3.47E-01	24,05/02/07	(302100, 6282400, 0.0)
76	3.46E-01	04,11/01/07	(302121, 6282333, 0.0)
77	3.46E-01	05,05/06/07	(302121, 6282333, 0.0)
78	3.45E-01	06,21/04/07	(302121, 6282333, 0.0)
79	3.44E-01	24,03/01/07	(302125, 6282392, 0.0)
80	3.43E-01	24,13/06/07	(302139, 6282361, 0.0)
81	3.43E-01	08,03/06/07	(302125, 6282346, 0.0)
82	3.43E-01	21,26/08/07	(302125, 6282346, 0.0)
83	3.43E-01	22,09/03/07	(302125, 6282346, 0.0)
84	3.43E-01	19,01/06/07	(302129, 6282326, 0.0)
85	3.42E-01	24,14/02/07	(302137, 6282311, 0.0)
86	3.41E-01	01,23/03/07	(302121, 6282333, 0.0)
87	3.41E-01	08,22/04/07	(302093, 6282334, 0.0)
88	3.40E-01	05,03/04/07	(302121, 6282333, 0.0)
89	3.39E-01	06,30/01/07	(302121, 6282333, 0.0)
90	3.39E-01	22,10/03/07	(302121, 6282333, 0.0)
91	3.38E-01	01,01/12/07	(301990, 6282286, 0.0)
92	3.37E-01	24,20/09/07	(302125, 6282346, 0.0)
93	3.37E-01	23,13/04/07	(302125, 6282346, 0.0)
94	3.37E-01	01,06/02/07	(302100, 6282376, 0.0)
95	3.37E-01	24,30/01/07	(302124, 6282364, 0.0)
96	3.37E-01	02,20/01/07	(302106, 6282391, 0.0)
97	3.36E-01	05,07/12/07	(302139, 6282361, 0.0)
98	3.36E-01	21,21/07/07	(302126, 6282378, 0.0)
99	3.35E-01	01,19/02/07	(302124, 6282364, 0.0)
100	3.35E-01	23,13/03/07	(302145, 6282326, 0.0)

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Pitt Town

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Concentration or deposition	Concentration
Emission rate units	OUV/second
Concentration units	Odour_Units
Units conversion factor	1.00E+00
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	Yes
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Averaging time for sigma-theta values	60 min.

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Sigma-theta
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.100m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour

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Pitt Town

SOURCE CHARACTERISTICS

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STACK SOURCE: 1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
302077	6282351	0m	5m	0.11m	20C	0.5m/s

No building wake effects.

Emission rates by stability and wind speed, in OUV/second:

```
Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01
   Stability B:  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01
   Stability C:  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01  8.13E+01
   Stability D:  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02
   Stability E:  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02
   Stability F:  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02  1.42E+02

                 No gravitational settling or scavenging.


                  STACK SOURCE: 2

   X(m)     Y(m)   Ground Elev.  Stack Height  Diameter Temperature  Speed
 302077  6282351         0m            5m        0.08m       20C     0.5m/s

                       No building wake effects.

         Emission rates by stability and wind speed, in OUV/second:

Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability B:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability C:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability D:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01
   Stability E:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01
   Stability F:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01

                 No gravitational settling or scavenging.


                  STACK SOURCE: 3

   X(m)     Y(m)   Ground Elev.  Stack Height  Diameter Temperature  Speed
 302078  6282351         0m            5m        0.08m       20C     0.5m/s

                       No building wake effects.

         Emission rates by stability and wind speed, in OUV/second:

Wind speeds (m/s): < 1.5   1.5_ 3.1  3.1_ 5.1  5.1_ 8.2  8.2_10.8    >10.8
   Stability A:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability B:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability C:  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01  4.30E+01
   Stability D:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01
   Stability E:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01
   Stability F:  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01  7.53E+01

                 No gravitational settling or scavenging.

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                              Pitt Town

                           RECEPTOR LOCATIONS

                           _____________________

 The Cartesian receptor grid has the following x-values (or eastings):
 301700.m  301750.m  301800.m  301850.m  301900.m  301950.m  302000.m
 302050.m  302100.m  302150.m  302200.m  302250.m  302300.m  302350.m
 302400.m  302450.m  302500.m  302550.m  302600.m  302650.m  302700.m
 302750.m  302800.m  302850.m  302900.m  302950.m  303000.m  303050.m
 303100.m  303150.m  303200.m  303250.m  303300.m  303350.m  303400.m
 303450.m  303500.m  303550.m  303600.m  303650.m  303700.m  303750.m
 303800.m  303850.m  303900.m  303950.m  304000.m  304050.m  304100.m
 304150.m

 and these y-values (or northings):
6282100.m 6282150.m 6282200.m 6282250.m 6282300.m 6282350.m 6282400.m
6282450.m 6282500.m 6282550.m 6282600.m 6282650.m 6282700.m 6282750.m
6282800.m 6282850.m 6282900.m 6282950.m 6283000.m 6283050.m 6283100.m
6283150.m 6283200.m 6283250.m 6283300.m 6283350.m 6283400.m 6283450.m
6283500.m 6283550.m 6283600.m 6283650.m 6283700.m 6283750.m 6283800.m
6283850.m 6283900.m 6283950.m 6284000.m 6284050.m 6284100.m 6284150.m
6284200.m 6284250.m 6284300.m 6284350.m 6284400.m 6284450.m 6284500.m
6284550.m
```

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	302047	6282349	0.0	0.0	101	302245	6282265	0.0	0.0
2	302047	6282372	0.0	0.0	102	302196	6282204	0.0	0.0
3	302053	6282388	0.0	0.0	103	302124	6282171	0.0	0.0
4	302056	6282406	0.0	0.0	104	302059	6282174	0.0	0.0
5	302073	6282405	0.0	0.0	105	301951	6282187	0.0	0.0
6	302087	6282405	0.0	0.0	106	301927	6282196	0.0	0.0
7	302105	6282403	0.0	0.0	107	301877	6282247	0.0	0.0
8	302125	6282392	0.0	0.0	108	301855	6282311	0.0	0.0
9	302126	6282378	0.0	0.0	109	301857	6282375	0.0	0.0
10	302124	6282364	0.0	0.0	110	301895	6282476	0.0	0.0
11	302125	6282346	0.0	0.0	111	301902	6282504	0.0	0.0
12	302121	6282333	0.0	0.0	112	301962	6282534	0.0	0.0
13	302108	6282311	0.0	0.0	113	302003	6282561	0.0	0.0
14	302082	6282305	0.0	0.0	114	302068	6282561	0.0	0.0
15	302059	6282311	0.0	0.0	115	302146	6282567	0.0	0.0
16	302044	6282323	0.0	0.0	116	302233	6282567	0.0	0.0
17	302045	6282336	0.0	0.0	117	302291	6282512	0.0	0.0
18	302049	6282303	0.0	0.0	118	302352	6282411	0.0	0.0
19	302034	6282324	0.0	0.0	119	302355	6282333	0.0	0.0
20	302035	6282339	0.0	0.0	120	302339	6282249	0.0	0.0
21	302037	6282366	0.0	0.0	121	302319	6282191	0.0	0.0
22	302039	6282391	0.0	0.0	122	302271	6282160	0.0	0.0
23	302045	6282408	0.0	0.0	123	302200	6282136	0.0	0.0
24	302062	6282419	0.0	0.0	124	302142	6282135	0.0	0.0
25	302087	6282418	0.0	0.0	125	302043	6282134	0.0	0.0
26	302106	6282417	0.0	0.0	126	301976	6282133	0.0	0.0
27	302128	6282408	0.0	0.0	127	301913	6282135	0.0	0.0
28	302135	6282392	0.0	0.0	128	301830	6282158	0.0	0.0
29	302139	6282377	0.0	0.0	129	301796	6282196	0.0	0.0
30	302139	6282361	0.0	0.0	130	301796	6282287	0.0	0.0
31	302138	6282347	0.0	0.0	131	301785	6282357	0.0	0.0
32	302129	6282326	0.0	0.0	132	301792	6282411	0.0	0.0
33	302125	6282310	0.0	0.0	133	301807	6282482	0.0	0.0
34	302117	6282297	0.0	0.0	134	301848	6282539	0.0	0.0
35	302105	6282292	0.0	0.0	135	301880	6282570	0.0	0.0
36	302084	6282288	0.0	0.0	136	301916	6282407	0.0	0.0
37	302068	6282288	0.0	0.0	137	301924	6282360	0.0	0.0
38	302044	6282292	0.0	0.0	138	301924	6282300	0.0	0.0
39	302026	6282300	0.0	0.0	139	301944	6282246	0.0	0.0
40	302018	6282318	0.0	0.0	140	301998	6282219	0.0	0.0
41	302013	6282334	0.0	0.0	141	302026	6282216	0.0	0.0
42	302015	6282354	0.0	0.0	142	302247	6282403	0.0	0.0
43	302013	6282375	0.0	0.0	143	302254	6282482	0.0	0.0
44	302016	6282393	0.0	0.0	144	302334	6282555	0.0	0.0
45	302026	6282412	0.0	0.0	145	302330	6282488	0.0	0.0
46	302036	6282422	0.0	0.0	146	302407	6282482	0.0	0.0
47	302064	6282433	0.0	0.0	147	302388	6282349	0.0	0.0
48	302082	6282433	0.0	0.0	148	302387	6282304	0.0	0.0
49	302103	6282430	0.0	0.0	149	302385	6282216	0.0	0.0
50	302124	6282420	0.0	0.0	150	302371	6282156	0.0	0.0
51	302141	6282411	0.0	0.0	151	301776	6282129	0.0	0.0
52	302153	6282399	0.0	0.0	152	301762	6282165	0.0	0.0
53	302154	6282376	0.0	0.0	153	301745	6282241	0.0	0.0
54	302154	6282360	0.0	0.0	154	301735	6282306	0.0	0.0
55	302145	6282326	0.0	0.0	155	301740	6282397	0.0	0.0
56	302137	6282311	0.0	0.0	156	301747	6282455	0.0	0.0
57	302121	6282278	0.0	0.0	157	302446	6282396	0.0	0.0
58	302091	6282274	0.0	0.0	158	302460	6282273	0.0	0.0
59	302071	6282272	0.0	0.0	159	302447	6282214	0.0	0.0
60	302048	6282272	0.0	0.0	160	302441	6282171	0.0	0.0
61	302021	6282282	0.0	0.0	161	302061	6282212	0.0	0.0
62	302009	6282290	0.0	0.0	162	302059	6282333	0.0	0.0
63	301996	6282310	0.0	0.0	163	302066	6282348	0.0	0.0
64	301991	6282336	0.0	0.0	164	302067	6282363	0.0	0.0
65	301991	6282368	0.0	0.0	165	302070	6282381	0.0	0.0
66	301993	6282390	0.0	0.0	166	302083	6282389	0.0	0.0
67	302018	6282419	0.0	0.0	167	302099	6282388	0.0	0.0
68	302031	6282436	0.0	0.0	168	302100	6282376	0.0	0.0
69	302044	6282447	0.0	0.0	169	302087	6282375	0.0	0.0
70	302077	6282452	0.0	0.0	170	302087	6282362	0.0	0.0
71	302121	6282445	0.0	0.0	171	302097	6282363	0.0	0.0
72	302141	6282436	0.0	0.0	172	302101	6282352	0.0	0.0
73	302154	6282427	0.0	0.0	173	302094	6282345	0.0	0.0
74	302173	6282397	0.0	0.0	174	302093	6282334	0.0	0.0
75	302178	6282385	0.0	0.0	175	302098	6282326	0.0	0.0
76	302171	6282361	0.0	0.0	176	302080	6282324	0.0	0.0
77	302170	6282352	0.0	0.0	177	302066	6282329	0.0	0.0

78	302160	6282330	0.0	0.0	178	302074	6282338	0.0	0.0
79	302162	6282319	0.0	0.0	179	302080	6282342	0.0	0.0
80	302165	6282299	0.0	0.0	180	302080	6282357	0.0	0.0
81	302155	6282287	0.0	0.0	181	302072	6282369	0.0	0.0
82	302139	6282273	0.0	0.0	182	302078	6282377	0.0	0.0
83	302153	6282310	0.0	0.0	183	302075	6282390	0.0	0.0
84	302141	6282298	0.0	0.0	184	302088	6282330	0.0	0.0
85	302138	6282291	0.0	0.0	185	302102	6282344	0.0	0.0
86	302122	6282264	0.0	0.0	186	302106	6282374	0.0	0.0
87	302100	6282261	0.0	0.0	187	302106	6282391	0.0	0.0
88	302087	6282258	0.0	0.0	188	302191	6282427	0.0	0.0
89	302048	6282255	0.0	0.0	189	302206	6282378	0.0	0.0
90	302038	6282257	0.0	0.0	190	302218	6282318	0.0	0.0
91	302007	6282272	0.0	0.0	191	302214	6282264	0.0	0.0
92	301990	6282286	0.0	0.0	192	302179	6282336	0.0	0.0
93	301976	6282301	0.0	0.0	193	301916	6282294	0.0	0.0
94	301954	6282403	0.0	0.0	194	301971	6282266	0.0	0.0
95	301959	6282437	0.0	0.0	195	302096	6282223	0.0	0.0
96	302001	6282490	0.0	0.0	196	302161	6282223	0.0	0.0
97	302124	6282510	0.0	0.0	197	302182	6282278	0.0	0.0
98	302208	6282470	0.0	0.0	198	301765	6282569	0.0	0.0
99	302280	6282411	0.0	0.0	199	301746	6282488	0.0	0.0
100	302273	6282334	0.0	0.0	200	302193	6282537	0.0	0.0

METEOROLOGICAL DATA : Meteorological file from Met MANAGER: CSV to AUSPLUME

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1 Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	2.57E+00	03,01/01/07	(302126, 6282378, 0.0)
2	2.52E+00	22,01/09/07	(302035, 6282339, 0.0)
3	2.42E+00	22,13/02/07	(302105, 6282403, 0.0)
4	2.37E+00	24,20/02/07	(302087, 6282405, 0.0)
5	2.34E+00	23,13/02/07	(302125, 6282346, 0.0)
6	2.26E+00	04,13/04/07	(302034, 6282324, 0.0)
7	2.25E+00	23,14/02/07	(302125, 6282346, 0.0)
8	2.24E+00	23,10/03/07	(302145, 6282326, 0.0)
9	2.23E+00	05,15/04/07	(302129, 6282326, 0.0)
10	2.22E+00	05,27/04/07	(302034, 6282324, 0.0)
11	2.21E+00	24,14/03/07	(302129, 6282326, 0.0)
12	2.20E+00	23,22/07/07	(302125, 6282346, 0.0)
13	2.19E+00	05,11/03/07	(302125, 6282346, 0.0)
14	2.16E+00	02,23/01/07	(302126, 6282378, 0.0)
15	2.10E+00	07,07/08/07	(302121, 6282333, 0.0)
16	2.09E+00	02,01/04/07	(302045, 6282336, 0.0)
17	2.08E+00	05,03/03/07	(302129, 6282326, 0.0)
18	2.08E+00	24,01/04/07	(302034, 6282324, 0.0)
19	2.07E+00	07,19/04/07	(302044, 6282323, 0.0)
20	2.07E+00	03,19/02/07	(302139, 6282361, 0.0)
21	2.07E+00	18,26/05/07	(302139, 6282361, 0.0)
22	2.05E+00	03,13/05/07	(302125, 6282346, 0.0)
23	2.05E+00	23,29/08/07	(302106, 6282374, 0.0)
24	2.05E+00	23,17/02/07	(302037, 6282366, 0.0)
25	2.04E+00	07,18/03/07	(302125, 6282346, 0.0)
26	2.03E+00	23,22/06/07	(302121, 6282333, 0.0)
27	2.02E+00	01,15/12/07	(302121, 6282333, 0.0)
28	2.01E+00	05,14/01/07	(302100, 6282400, 0.0)
29	2.00E+00	07,27/05/07	(302087, 6282405, 0.0)
30	1.98E+00	22,28/03/07	(302124, 6282364, 0.0)
31	1.96E+00	01,30/12/07	(302125, 6282346, 0.0)
32	1.96E+00	07,09/05/07	(302124, 6282364, 0.0)
33	1.96E+00	24,30/07/07	(302045, 6282336, 0.0)
34	1.96E+00	22,19/04/07	(302125, 6282346, 0.0)
35	1.95E+00	19,27/05/07	(302125, 6282346, 0.0)
36	1.94E+00	22,27/08/07	(302125, 6282346, 0.0)
37	1.92E+00	22,27/04/07	(302137, 6282311, 0.0)
38	1.91E+00	24,13/03/07	(302125, 6282346, 0.0)
39	1.90E+00	02,11/01/07	(302100, 6282376, 0.0)
40	1.90E+00	17,26/05/07	(302126, 6282378, 0.0)
41	1.88E+00	21,13/03/07	(302125, 6282392, 0.0)
42	1.88E+00	18,19/04/07	(302129, 6282326, 0.0)
43	1.88E+00	02,09/04/07	(302125, 6282346, 0.0)

44	1.88E+00	03,20/01/07	(302106, 6282391,	0.0)
45	1.88E+00	22,14/05/07	(302126, 6282378,	0.0)
46	1.87E+00	02,30/10/07	(302125, 6282346,	0.0)
47	1.85E+00	22,14/02/07	(302039, 6282391,	0.0)
48	1.85E+00	17,08/07/07	(302124, 6282364,	0.0)
49	1.85E+00	24,14/01/07	(302124, 6282364,	0.0)
50	1.85E+00	24,13/02/07	(302138, 6282347,	0.0)
51	1.85E+00	23,14/03/07	(302129, 6282326,	0.0)
52	1.85E+00	24,27/08/07	(302044, 6282323,	0.0)
53	1.85E+00	02,02/04/07	(302035, 6282339,	0.0)
54	1.85E+00	06,13/09/07	(302099, 6282388,	0.0)
55	1.85E+00	08,13/09/07	(302099, 6282388,	0.0)
56	1.82E+00	23,03/02/07	(302087, 6282405,	0.0)
57	1.82E+00	21,27/04/07	(302121, 6282333,	0.0)
58	1.82E+00	20,30/11/07	(301990, 6282286,	0.0)
59	1.82E+00	04,24/03/07	(302125, 6282346,	0.0)
60	1.82E+00	18,27/04/07	(302108, 6282311,	0.0)
61	1.81E+00	23,14/05/07	(302124, 6282364,	0.0)
62	1.81E+00	22,16/04/07	(302121, 6282333,	0.0)
63	1.80E+00	01,15/05/07	(302045, 6282336,	0.0)
64	1.80E+00	03,04/04/07	(302125, 6282392,	0.0)
65	1.79E+00	05,12/01/07	(302121, 6282333,	0.0)
66	1.77E+00	04,12/04/07	(302099, 6282388,	0.0)
67	1.77E+00	23,12/11/07	(302087, 6282405,	0.0)
68	1.76E+00	23,10/05/07	(302105, 6282403,	0.0)
69	1.76E+00	17,27/05/07	(302138, 6282347,	0.0)
70	1.75E+00	03,23/04/07	(302124, 6282364,	0.0)
71	1.75E+00	03,21/12/07	(302121, 6282333,	0.0)
72	1.75E+00	08,12/04/07	(302097, 6282363,	0.0)
73	1.74E+00	23,20/01/07	(302125, 6282392,	0.0)
74	1.73E+00	19,10/05/07	(302106, 6282391,	0.0)
75	1.73E+00	24,05/02/07	(302100, 6282400,	0.0)
76	1.73E+00	04,11/01/07	(302121, 6282333,	0.0)
77	1.73E+00	05,05/06/07	(302121, 6282333,	0.0)
78	1.72E+00	06,21/04/07	(302121, 6282333,	0.0)
79	1.72E+00	24,03/01/07	(302125, 6282392,	0.0)
80	1.71E+00	24,13/06/07	(302139, 6282361,	0.0)
81	1.71E+00	08,03/06/07	(302125, 6282346,	0.0)
82	1.71E+00	21,26/08/07	(302125, 6282346,	0.0)
83	1.71E+00	22,09/03/07	(302125, 6282346,	0.0)
84	1.71E+00	19,01/06/07	(302129, 6282326,	0.0)
85	1.71E+00	24,14/02/07	(302137, 6282311,	0.0)
86	1.70E+00	01,23/03/07	(302121, 6282333,	0.0)
87	1.70E+00	08,22/04/07	(302093, 6282334,	0.0)
88	1.70E+00	05,03/04/07	(302121, 6282333,	0.0)
89	1.69E+00	06,30/01/07	(302121, 6282333,	0.0)
90	1.69E+00	22,10/03/07	(302121, 6282333,	0.0)
91	1.69E+00	01,01/12/07	(301990, 6282286,	0.0)
92	1.68E+00	24,20/09/07	(302125, 6282346,	0.0)
93	1.68E+00	23,13/04/07	(302125, 6282346,	0.0)
94	1.68E+00	01,06/02/07	(302100, 6282376,	0.0)
95	1.68E+00	24,30/01/07	(302124, 6282364,	0.0)
96	1.68E+00	02,20/01/07	(302106, 6282391,	0.0)
97	1.68E+00	05,07/12/07	(302139, 6282361,	0.0)
98	1.68E+00	21,21/07/07	(302126, 6282378,	0.0)
99	1.67E+00	01,19/02/07	(302124, 6282364,	0.0)
100	1.67E+00	23,13/03/07	(302145, 6282326,	0.0)

SECTION K

Architectural Drawings

PITT TOWN WATER FACTORY

DRAWING REGISTER

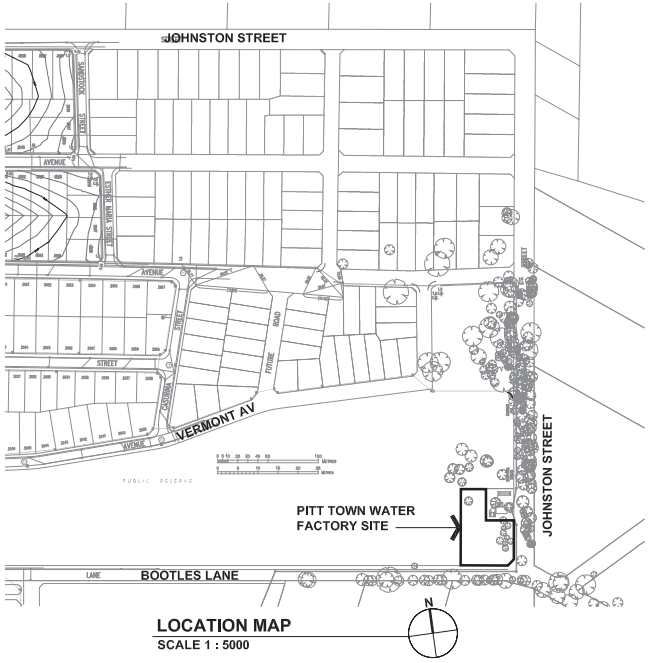
SK00	DRAWING REGISTER & LOCATION MAP
SK01	SITE PLAN
SK03	ELEVATIONS
SK04	ELEVATIONS
SK05	SECTIONS
SK06	SITE PLAN-TEMPORARY CONSTRUCTION FENCE
SK07	SERVICES PLAN

VIEW FROM BOOTLES LANE

VIEW FROM JOHNSTON STREET

LOADING AREA

ENTRY CANOPY



LOCATION MAP
SCALE 1 : 5000

Rev	Date	Amendment	Initials	Check
A	22/03/10	ISSUE FOR DISCUSSION	VC	–
B	24/03/10	ISSUE FOR DISCUSSION	VC	–
C	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
E	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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SURVEY NOTES

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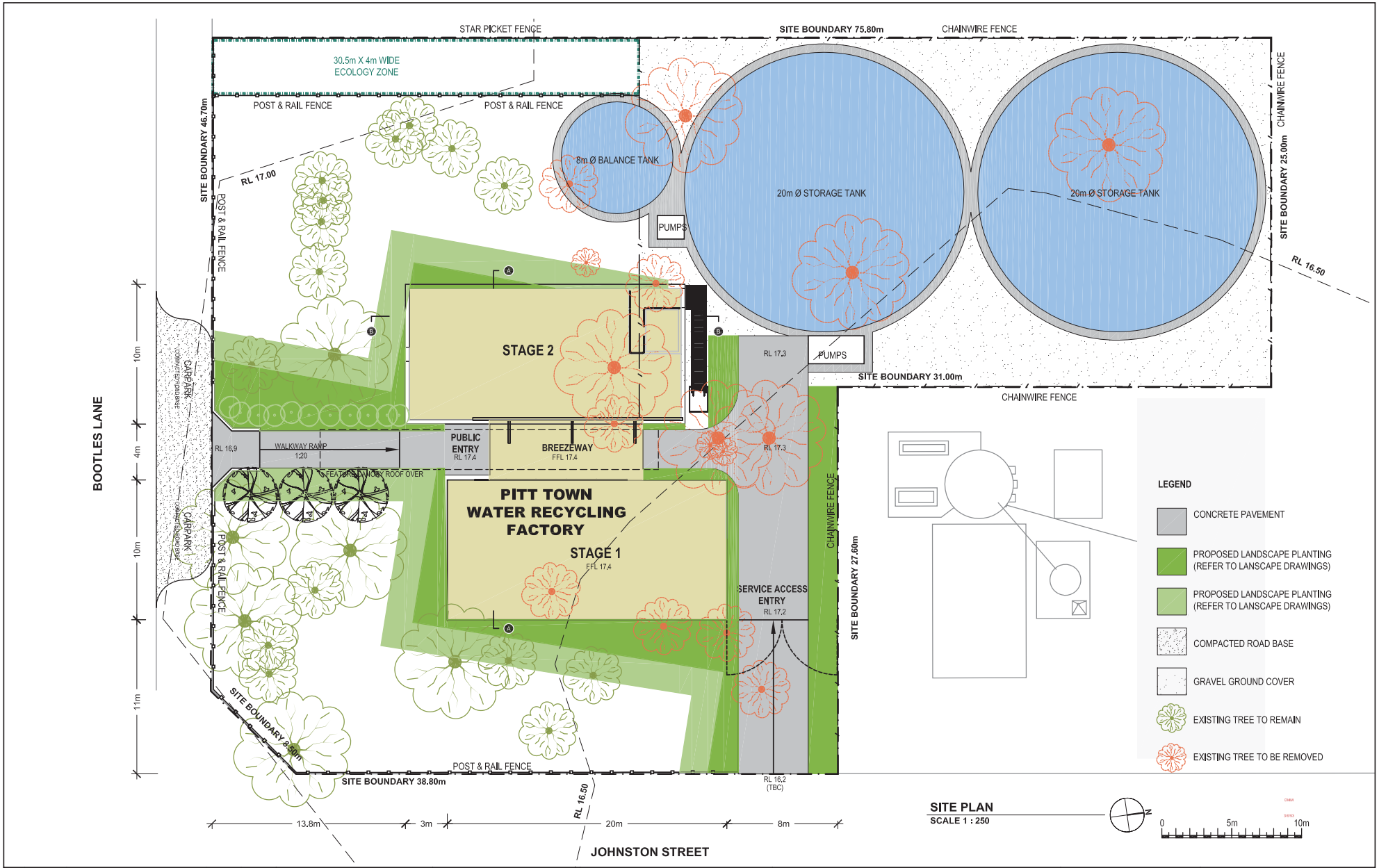
Architects
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: DRAWING REGISTER & LOCATION MAP

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: SK00
Revision: E



SITE PLAN
SCALE 1 : 250

0 5m 10m

Rev	Date	Amendment	Initials	Check
A	22/03/10	ISSUE FOR CLIENT REVIEW	VC	–
B	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–
C	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
E	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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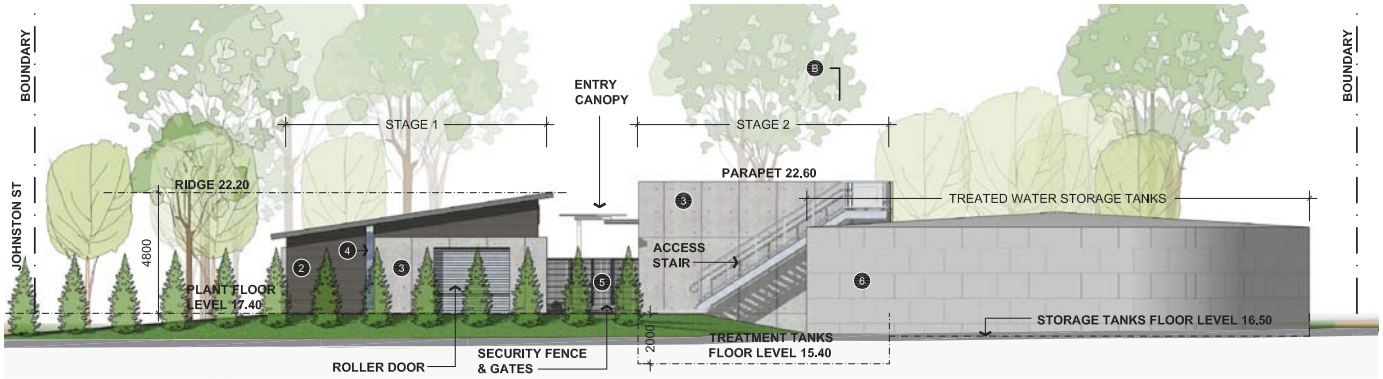
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **SITE PLAN**
Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

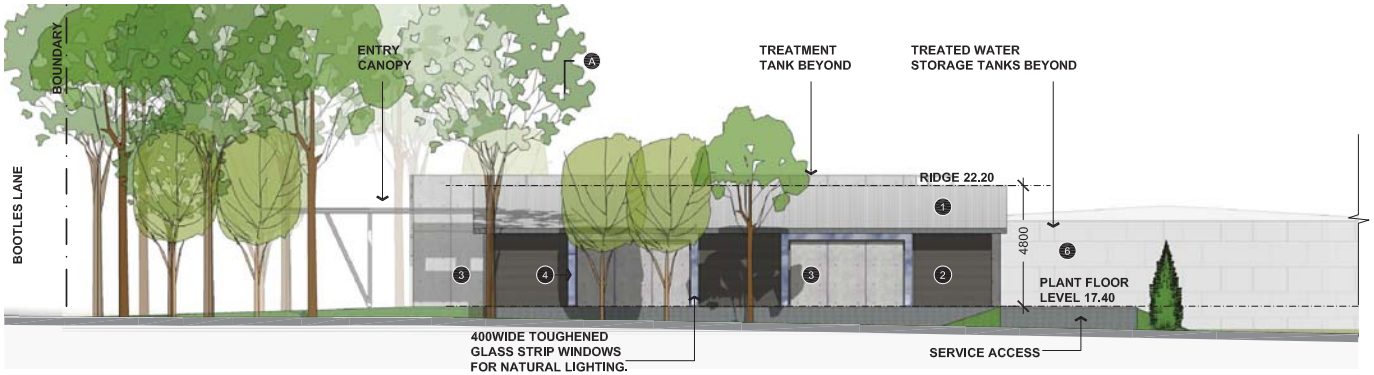
Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK01**
Revision: **E**



NORTH ELEVATION

SCALE 1 : 200

0 5 10m



EAST ELEVATION (VIEW FROM JOHNSTON ST.)

SCALE 1 : 200

0 5 10m

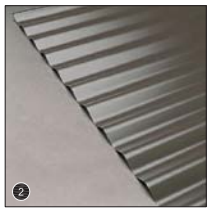
NOTES:

1. FINAL DIMENSIONS TO BE CONFIRMED DURING THE CONSTRUCTION DOCUMENTATION STAGE.
2. SITE FENCE NOT SHOWN FOR CLARITY.
3. ALL SERVICES SHOWN ARE DIAGRAMATIC & TO BE CONFIMRED DURING CONSTRUCTION.
4. 1 : 100 FLOOD PLAIN RL17.30
5. ALL LEVELS ARE SUBJECT TO PROVISION OF DETAIL SURVEY.

EXTERNAL MATERIALS & FINISHES SCHEDULE

MATERIAL : COLORBOND CUSTOM ORB

COLOUR : SHALE GREY



MATERIAL : COLORBOND CUSTOM ORB

COLOUR : WOODLAND GREY

MATERIAL : OFF-FORM CONCRETE

COLOUR : NATURAL

MATERIAL : ALUMINIUM WINDOW

COLOUR : CLEAR ANODISED

MATERIAL : MESH FENCING

COLOUR : GALVANISED

MATERIAL : STEEL

COLOUR : PALE EUCALYPT

Rev	Date	Amendment	Initials	Check
A	22/03/10	ISSUE FOR CLIENT REVIEW	VC	–
B	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–
C	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
E	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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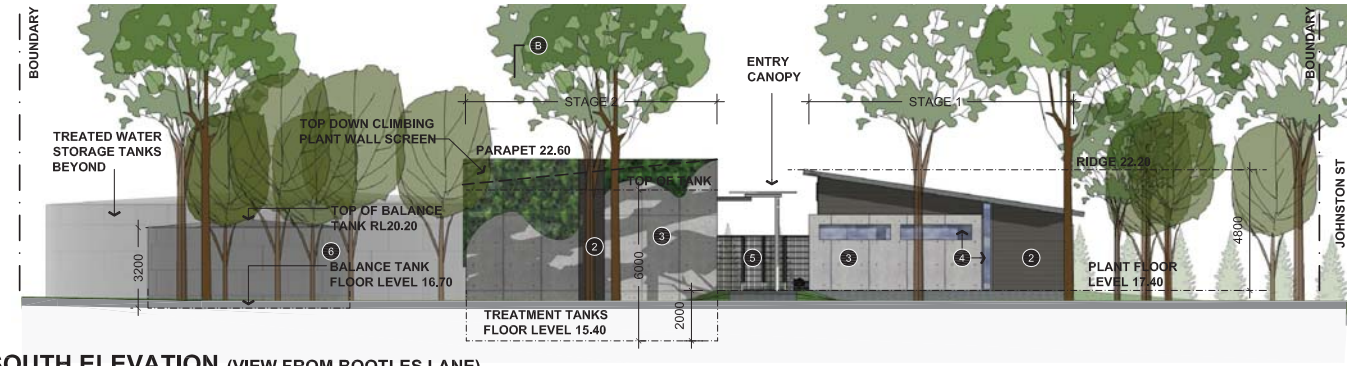
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **ELEVATIONS 1**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

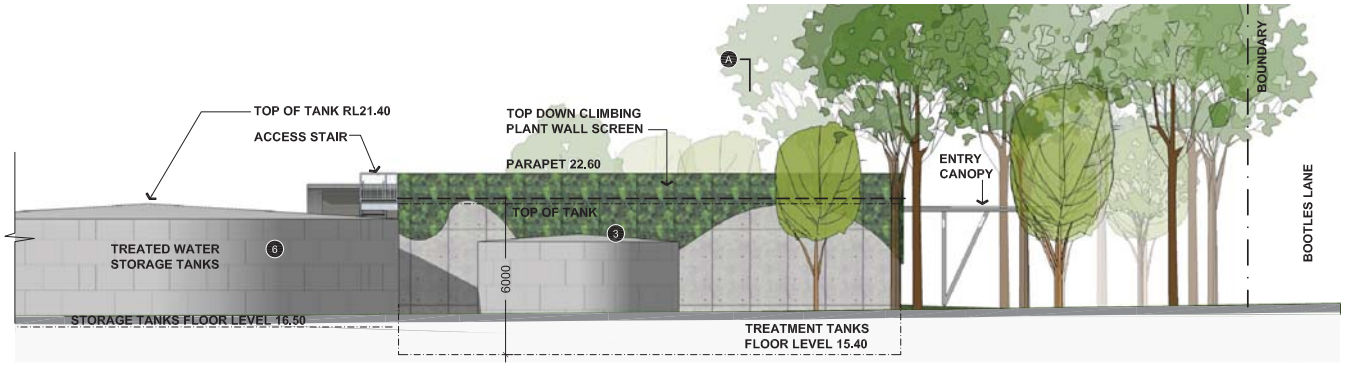
Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK03**
Revision: **E**



SOUTH ELEVATION (VIEW FROM BOOTLES LANE)

SCALE 1 : 200

0 5 10m



WEST ELEVATION

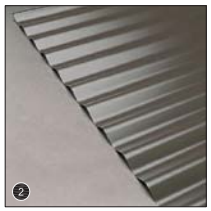
SCALE 1 : 200

0 5 10m

EXTERNAL MATERIALS & FINISHES SCHEDULE

MATERIAL : COLORBOND CUSTOM ORB

COLOUR : SHALE GREY



MATERIAL : COLORBOND CUSTOM ORB

COLOUR : WOODLAND GREY

MATERIAL : OFF-FORM CONCRETE

COLOUR : NATURAL

MATERIAL : ALUMINIUM WINDOW

COLOUR : CLEAR ANODISED

MATERIAL : MESH FENCING

COLOUR : GALVANISED

MATERIAL : STEEL

COLOUR : PALE EUCALYPT

NOTES:

1. FINAL DIMENSIONS TO BE CONFIRMED DURING THE CONSTRUCTION DOCUMENTATION STAGE.
2. SITE FENCE NOT SHOWN FOR CLARITY.
3. ALL SERVICES SHOWN ARE DIAGRAMATIC & TO BE CONFIMRED DURING CONSTRUCTION.
4. 1 : 100 FLOOD PLAIN RL17.30
5. ALL LEVELS ARE SUBJECT TO PROVISION OF DETAIL SURVEY.

Rev	Date	Amendment	Initials	Check
A	22/03/10	ISSUE FOR CLIENT REVIEW	VC	–
B	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–
C	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
E	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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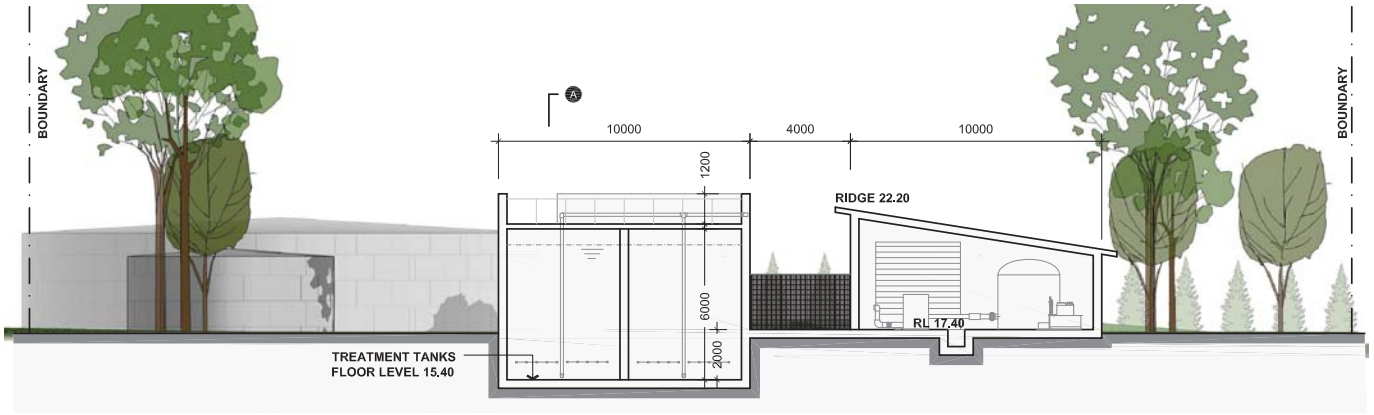
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **ELEVATIONS 2**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

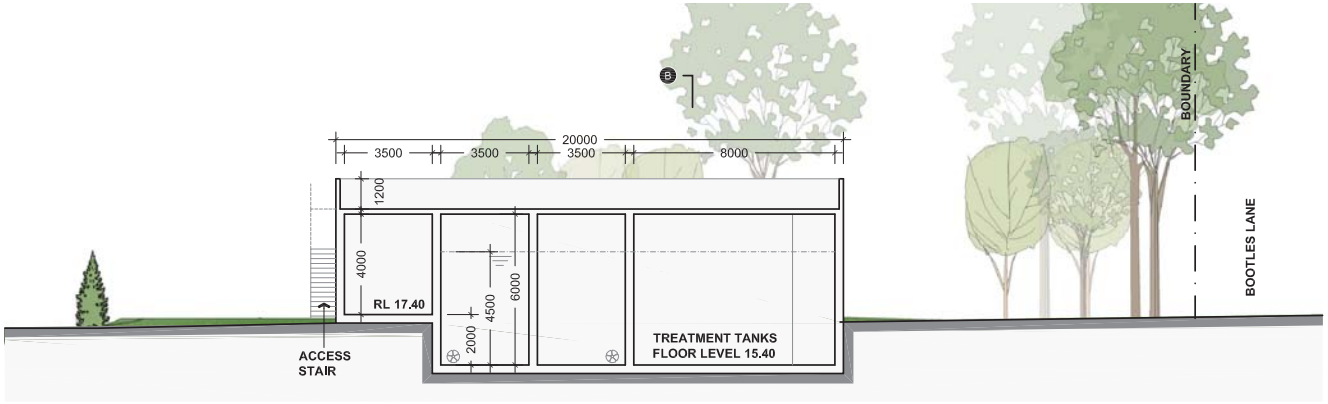
Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK04**
Revision: **E**



SECTION A-A

SCALE 1 : 200

0 5 10m



SECTION B-B

SCALE 1 : 200

0 5 10m

NOTES:

1. FINAL DIMENSIONS TO BE CONFIRMED DURING THE CONSTRUCTION DOCUMENTATION STAGE.
2. SITE FENCE NOT SHOWN FOR CLARITY.
3. ALL SERVICES SHOWN ARE DIAGRAMATIC & TO BE CONFIMRED DURING CONSTRUCTION.
4. 1 : 100 FLOOD PLAIN RL17.30
5. ALL LEVELS ARE SUBJECT TO PROVISION OF DETAIL SURVEY.

Rev	Date	Amendment	Initials	Check
A	22/03/10	ISSUE FOR CLIENT REVIEW	VC	–
B	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–
C	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
E	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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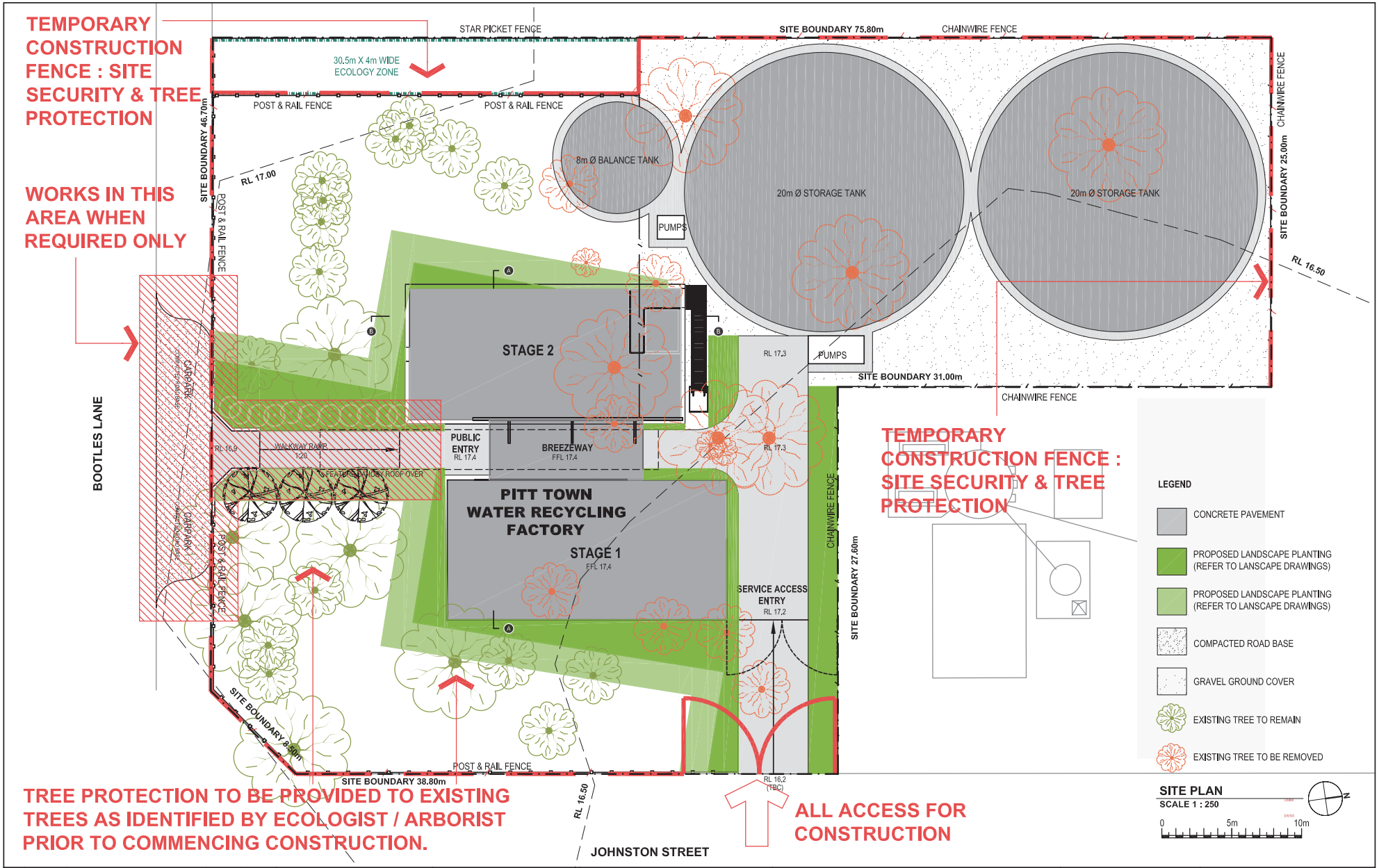
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **SECTIONS**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK05**
Revision: **E**



Rev	Date	Amendment	Initials	Check
A	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–
B	29/03/10	ISSUE FOR CLIENT REVIEW	VC	–
C	30/03/10	ISSUE FOR CLIENT REVIEW	VC	–
D	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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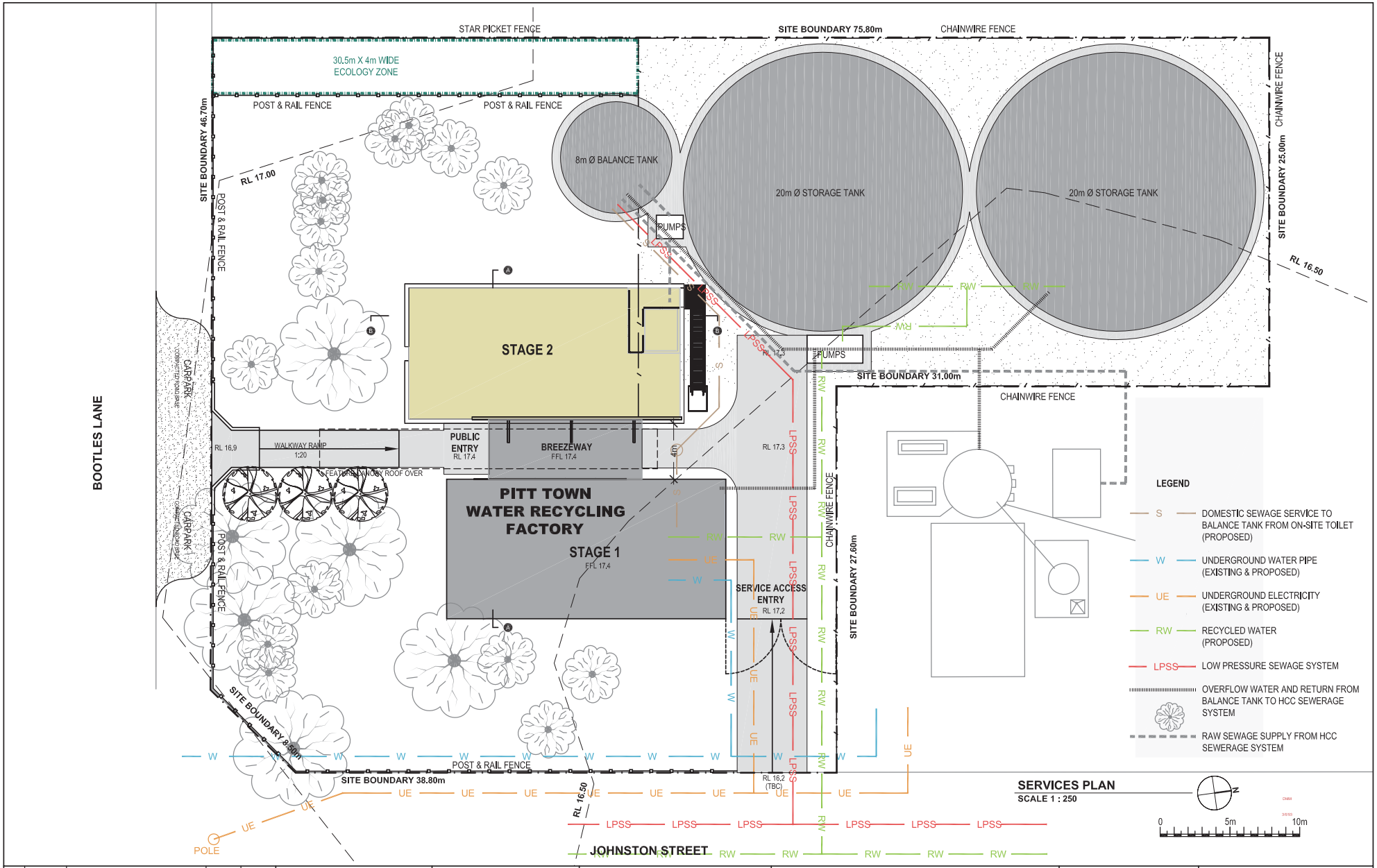
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **SITE PLAN-TEMPORARY CONSTRUCTION FENCE**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK06**
Revision: **D**



Rev	Date	Amendment	Initials	Check
B	07/04/10	ISSUE FOR CLIENT REVIEW	VC	–
A	23/03/10	ISSUE FOR CLIENT REVIEW	VC	–

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ARCHITECTS
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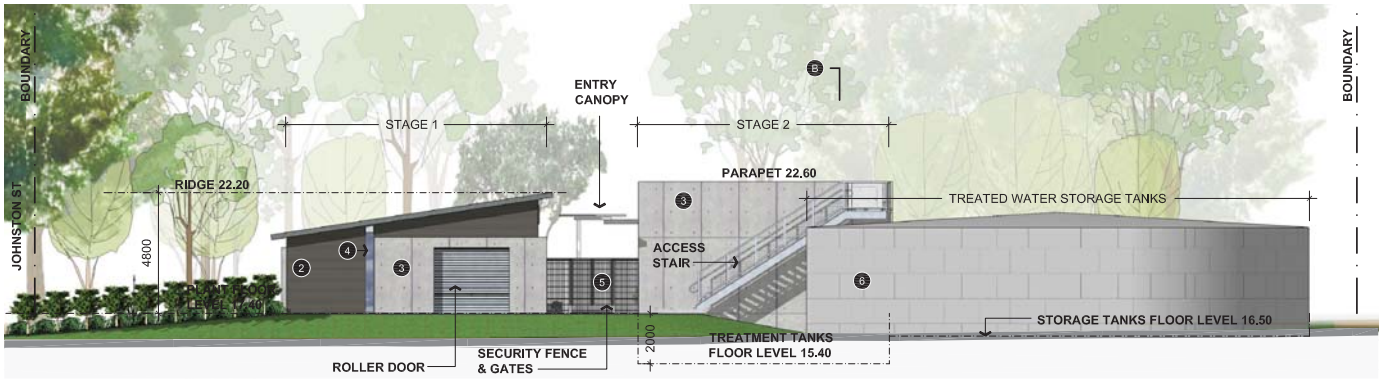
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **SERVICES PLAN**

Project: **PITT TOWN WATER FACTORY**

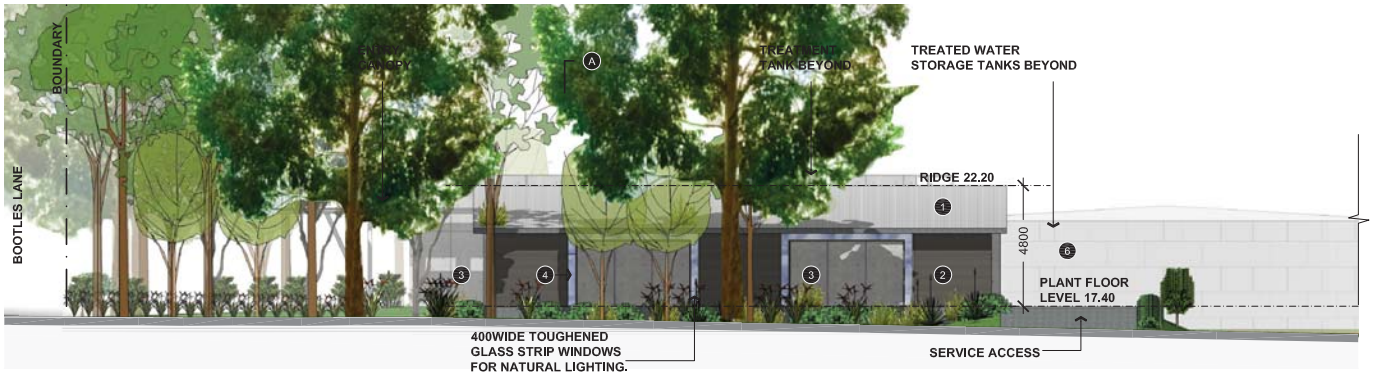
Scale:	AS SHOWN
Drawn:	VC
Checked:	GO
North:	
Date:	MARCH 2010
Project Principal:	G. OLLERTON
Project Number:	2632
Drawing Number:	SK07
Revision:	B



NORTH ELEVATION

SCALE 1 : 200

0 5 10m



EAST ELEVATION (VIEW FROM JOHNSTON ST.)

SCALE 1 : 200

0 5 10m

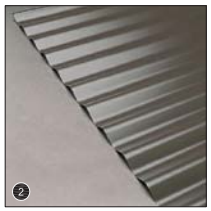
NOTES:

1. FINAL DIMENSIONS TO BE CONFIRMED DURING THE CONSTRUCTION DOCUMENTATION STAGE.
2. SITE FENCE NOT SHOWN FOR CLARITY.
3. ALL SERVICES SHOWN ARE DIAGRAMATIC & TO BE CONFIMRED DURING CONSTRUCTION.
4. 1 : 100 FLOOD PLAIN RL17.30
5. ALL LEVELS ARE SUBJECT TO PROVISION OF DETAIL SURVEY.

EXTERNAL MATERIALS & FINISHES SCHEDULE

MATERIAL : COLORBOND CUSTOM ORB

COLOUR : SHALE GREY



MATERIAL : COLORBOND CUSTOM ORB

COLOUR : WOODLAND GREY

MATERIAL : OFF-FORM CONCRETE

COLOUR : NATURAL

MATERIAL : ALUMINIUM WINDOW

COLOUR : CLEAR ANODISED

MATERIAL : MESH FENCING

COLOUR : GALVANISED

MATERIAL : STEEL

COLOUR : PALE EUCALYPT

Rev	Date	Amendment	Initials	Check
A	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

GENERAL NOTES

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This drawing shall be read in conjunction with all architectural and other consultants drawings and specifications and with such other written instructions as may be issued during the course of the contract.
Figured dimensions shall be taken in preference to scaling.
Level, datum points and dimensions on this drawing shall be verified by the builder on site.
All discrepancies shall be referred to the architect for direction before proceeding with any works.

SURVEY NOTES

Survey data included in this drawing is based on "Watson Bucher Pty Ltd" (registered surveyor), survey ref. 08/0629, dated 19th November 2008 and is provided for preliminary design purposes only.
As this drawing is based on information supplied by others, reference must be made to original survey drawings verified against site conditions.

This drawing is based on information supplied by others, and must not be relied upon unless checked against site conditions.

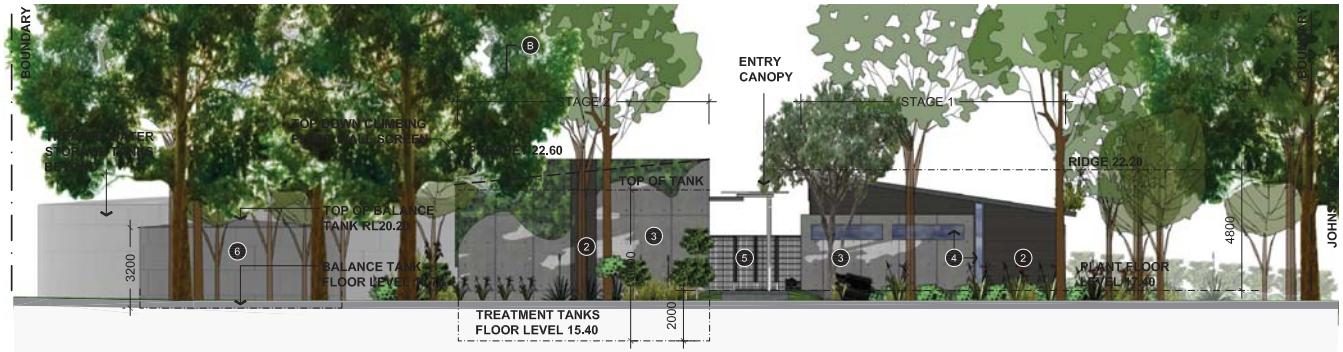
Architects
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **LANDSCAPED STREET ELEVATIONS 1**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

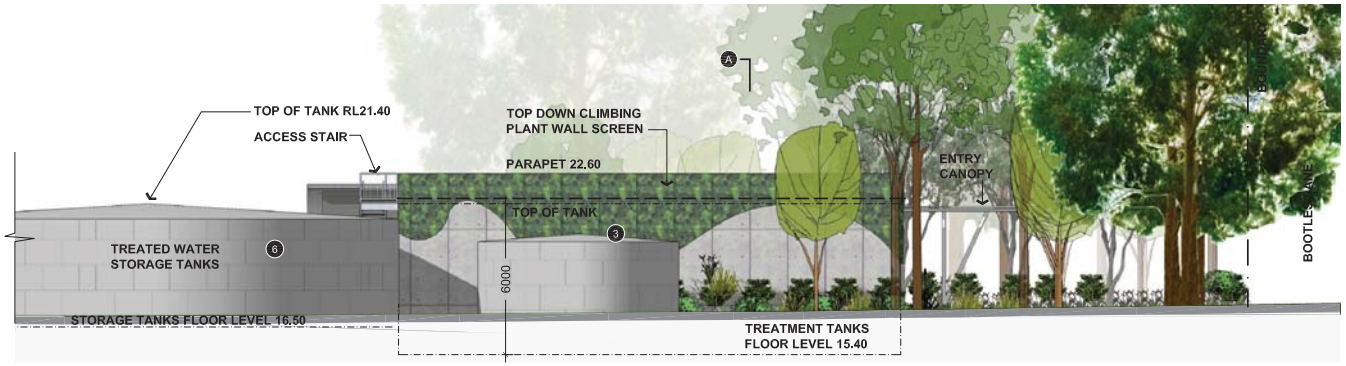
Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: SK08
Revision: A



SOUTH ELEVATION (VIEW FROM BOOTLES LANE)

SCALE 1 : 200

0 5 10m



WEST ELEVATION

SCALE 1 : 200

0 5 10m

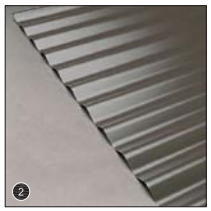
NOTES:

1. FINAL DIMENSIONS TO BE CONFIRMED DURING THE CONSTRUCTION DOCUMENTATION STAGE.
2. SITE FENCE NOT SHOWN FOR CLARITY.
3. ALL SERVICES SHOWN ARE DIAGRAMATIC & TO BE CONFIMRED DURING CONSTRUCTION.
4. 1 : 100 FLOOD PLAIN RL17.30
5. ALL LEVELS ARE SUBJECT TO PROVISION OF DETAIL SURVEY.

EXTERNAL MATERIALS & FINISHES SCHEDULE

MATERIAL : COLORBOND CUSTOM ORB

COLOUR : SHALE GREY



MATERIAL : COLORBOND CUSTOM ORB

COLOUR : WOODLAND GREY

MATERIAL : OFF-FORM CONCRETE

COLOUR : NATURAL

MATERIAL : ALUMINIUM WINDOW

COLOUR : CLEAR ANODISED

MATERIAL : MESH FENCING

COLOUR : GALVANISED

MATERIAL : STEEL

COLOUR : PALE EUCALYPT

Rev	Date	Amendment	Initials	Check
A	31/03/10	ISSUE FOR CLIENT REVIEW	VC	–

GENERAL NOTES

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Recipients should when necessary request a hard copy version for verification.
This drawing shall be read in conjunction with all architectural and other consultants drawings and specifications and with such other written instructions as may be issued during the course of the contract.
Figured dimensions shall be taken in preference to scaling.
Level, datum points and dimensions on this drawing shall be verified by the builder on site.
All discrepancies shall be referred to the architect for direction before proceeding with any works.

SURVEY NOTES

Survey data included in this drawing is based on "Watson Bucher Pty Ltd" (registered surveyor), survey ref. 08/0629, dated 19th November 2008 and is provided for preliminary design purposes only.
As this drawing is based on information supplied by others, reference must be made to original survey drawings verified against site conditions.

This drawing is based on information supplied by others, and must not be relied upon unless checked against site conditions.

Architects
Morrison Design Partnership
ARCHITECTS
ACN 001 595 288
Nominated Architect:
1/136 Willoughby Road,
CROWS NEST NSW 2065
Telephone: 02 9966 5566
Facsimile: 02 9966 8303
Email: morrisondesign@mdpa.com.au
GLEN OLLERTON AIA Reg No. 7621

Drawing: **LANDSCAPED STREET ELEVATIONS 2**

Project: **PITT TOWN WATER FACTORY**

Scale: AS SHOWN
Drawn: VC
Checked: GO
North:

Date: MARCH 2010
Project Principal: G. OLLERTON
Project Number: 2632
Drawing Number: **SK09**
Revision: **A**

SECTION K

Landscape Drawings

SITE IMAGE

Landscape Architects

DOCUMENT TRANSMITTAL / DRAWING REGISTER

PROJECT: PITT TOWN WATER FACTORY
NUMBER: SS10-2159

Page No.: 1 of 1

DATE OF ISSUE	DAY	19	30	**01**										
	MONTH	03	03	**04**										
	YEAR	10	10	**10**										

DOCUMENT NAME	**DWG NO.**	**ISSUE**												
LANDSCAPE CONCEPT PLAN	101	A	B	**C**										
COLOUR LANDSCAPE CONCEPT PLAN	102		A	**B**										
PLANTING PALETTE IMAGES	103		A											

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REASON FOR ISSUE														
	PRELIMINARY	X	X	**X**										
	FOR INFORMATION													
	FOR COMMENT													
	APPROVAL													
	DA APPROVAL													
	SECTION 96 APPROVAL													
	CC APPROVAL													
	TENDER													
	CONSTRUCTION													

DOCUMENT FORMAT														
	B&W PRINTS													
	COLOUR PRINTS													
	ELECTRONIC FILE (PDF)	X	X	**X**										
	ELECTRONIC FILE (DWG)													

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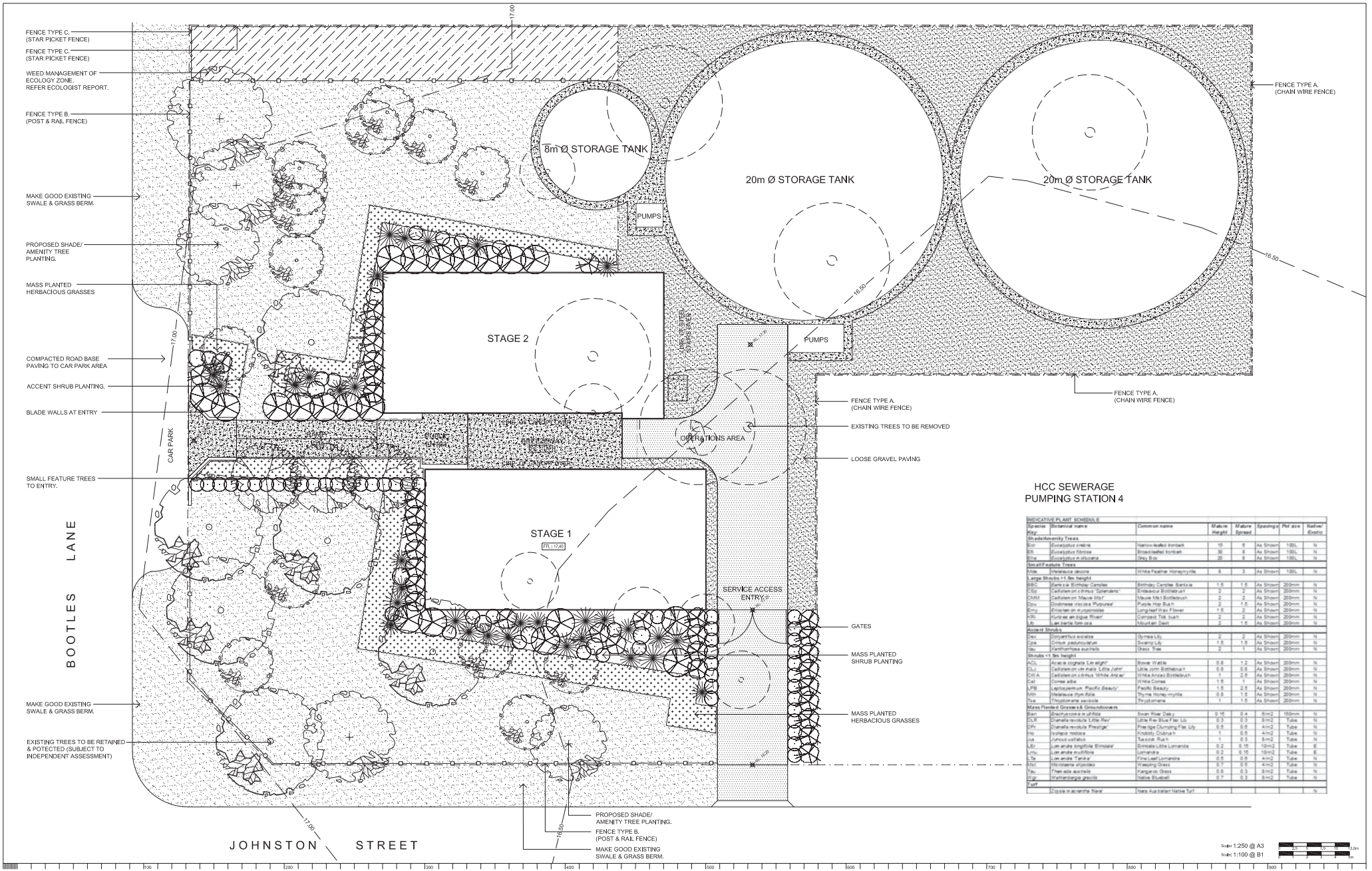
	FAX													
	EMAIL	X	X	**X**										
	FTP													

ISSUER	SITE IMAGE STAFF MEMBER	RS	GO	**GO**										



HCC SEWERAGE PUMPING STATION 4

INDICATIVE PLANT SCHEDULE

Species Key	Botanical name	Common name	Mature Height	Mature Spread	Spacing	Pot size	Native/ Exotic
Shade/Amenity Trees							
Eor	Eucalyptus orbifolia	Narrow-leafed Ironbark	15	6	As Shown	100L	N
Efi	Eucalyptus fibrosa	Broadleafed Ironbark	30	8	As Shown	100L	N
Eba	Eucalyptus baueriana	Grey Box	20	8	As Shown	100L	N
Small/Feature Trees							
Mde	Melaleuca decora	White Feather Honeymyrtle	8	3	As Shown	100L	N
Large Shrubs >1.5m height							
BBC	Banksia Birthday Candles	Birthday Candles Banksia	1.5	1.5	As Shown	200mm	N
CSp	Callistemon citrinus 'Splendens'	Endeavour Bottlebrush	2	2	As Shown	200mm	N
CMM	Callistemon 'Mauve Mist'	Mauve Mist Bottlebrush	2	2	As Shown	200mm	N
Dpu	Dodonaea viscosa 'Purpurea'	Purple Hop Bush	2	1.5	As Shown	200mm	N
Emy	Eriostemon myoporoides	Longleaf Wax Flower	1.5	2	As Shown	200mm	N
KRi	Kunzea ericoides 'Rigua River'	Compact Tick Bush	2	2	As Shown	200mm	N
Lfo	Lomandra fontinalis	Mountain Devil	2	1.5	As Shown	200mm	N
Accent Shrubs							
Dex	Doryanthus excelsa	Gymea Lily	2	2	As Shown	200mm	N
Cpa	Crinum pedunculatum	Swamp Lily	1.5	1.5	As Shown	200mm	N
Xau	Xanthorrhoea australis	Grass Tree	2	1	As Shown	200mm	N
Shrubs <1.5m height							
ACL	Acacia cognata 'Limelight'	Bower Wattle	0.8	1.2	As Shown	200mm	N
CLJ	Callistemon viminalis 'Little John'	Little John Bottlebrush	0.8	0.8	As Shown	200mm	N
CWA	Callistemon citrinus 'White Anzac'	White Anzac Bottlebrush	1	2.5	As Shown	200mm	N
Cal	Correa alba	White Correa	1.5	1	As Shown	200mm	N
LPB	Leptospermum 'Pacific Beauty'	Pacific Beauty	1.5	2.5	As Shown	200mm	N
Mth	Melaleuca thymifolia	Thyme Honeymyrtle	0.8	1.5	As Shown	200mm	N
Tsp	Thryptomene saxicola	Thryptomene	1	1.5	As Shown	200mm	N
Mass Planted Grasses & Groundcovers							
Ban	Brachyscome angustifolia	Swan River Daisy	0.15	0.4	6/m2	150mm	N
DLR	Dianella revoluta 'Little Rev'	Little Rev Blue Flax Lily	0.3	0.3	6/m2	Tube	N
DPr	Dianella revoluta 'Prestige'	Prestige Clumping Flax Lily	0.5	0.5	4/m2	Tube	N
Iro	Isolepis nodosa	Knobbly Clubrush	1	0.5	4/m2	Tube	N
Jus	Juncus usitatus	Tussock Rush	1	0.5	8/m2	Tube	N
LEr	Lomandra longifolia 'Emerald'	Emerald Little Lomandra	0.2	0.15	10/m2	Tube	E
Lmu	Lomandra multiflora	Lomandra	0.2	0.15	10/m2	Tube	E
LTa	Lomandra 'Tanika'	Fine Leaf Lomandra	0.6	0.6	4/m2	Tube	N
Mol	Microlaena stipoides	Weeping Grass	0.7	0.5	4/m2	Tube	N
Tau	Themeda australis	Kangaroo Grass	0.8	0.3	8/m2	Tube	N
Wgr	Wahlenbergia gracilis	Native Bluebell	0.7	0.3	8/m2	Tube	N
Turf							
	Cynodon x dactylon 'Nara'	Nara Australian Native Turf					N

Scale 1:250 @ A3
Scale 1:100 @ B1

The contractor shall check and verify all work on site (including work by others) before commencing the landscape installation. Any discrepancies are to be reported to the Project Manager or Landscape Architect prior to commencing work. Do not scale this drawing. Any required dimensions not shown shall be referred to the Landscape Architect for confirmation.

Issue	Revision Description	Drawn	Check	Date
C	For Client Review & Comment	PH	GO	01.04.2010
B	For Client Review & Comment	PH	GO	26.03.2010
A	For Client Review & Comment	PH	RS	19.03.2010

LEGEND

- LOT BOUNDARY
- PROPOSED BUILDING LINE.
- GARDEN EDGE.
- FENCE TYPE A. (CHAIN/WIRE FENCE) REFER TO ARCHITECTS DETAILS.
- FENCE TYPE B. (POST & RAIL FENCE) REFER TO ARCHITECTS DETAILS.
- FENCE TYPE C. (STAR PICKET FENCE) REFER TO ARCHITECTS DETAILS.
- INSITU CONCRETE PAVING.
- ROAD PAVING. BY OTHERS, REFER ARCHITECTS DRAWINGS.
- LOOSE GRAVEL PAVING.
- EXISTING TREE TO BE RETAINED & PROTECTED.
- EXISTING TREE TO BE REMOVED.
- SHADE AMENITY TREE. REFER PLANT SCHEDULE.
- SMALL FEATURE TREE. REFER PLANT SCHEDULE.
- SHRUB PLANTING. REFER PLANT SCHEDULE.
- ACCENT SHRUB PLANTING. REFER PLANT SCHEDULE.
- GROUNDCOVER & GRASSES PLANTING. REFER PLANT SCHEDULE.
- ECOLOGY ZONE. REFER ECOLOGY REPORT.
- TURF. REFER PLANT SCHEDULE.

SITE IMAGE
Landscape Architects
28 Bowden Street
Alexandria NSW 2015 Australia
Tel (61 2) 9698 2699
Fax (61 2) 9698 2877
www.siteimage.com.au
Site Image (NSW) Pty Ltd
ABN 44 601 262 380

Client:
WATER FACTORY COMPANY PTY LTD

Project:
PITT TOWN WATER FACTORY

Drawing Name:
LANDSCAPE CONCEPT PLAN

Sheet 1 of 1

PRELIMINARY

Job Number: SS10-2159
Drawing Number: 101
Issue: C

B1

HCC SEWERAGE PUMPING STATION 4

INDICATIVE PLANT SCHEDULE

Species Key	Botanical name	Common name	Mature Height	Mature Spread	Spacings	Pot size	Native/ Exotic
Shade/Amenity Trees							
Ecr	*Eucalyptus crebra*	Narrow-leafed Ironbark	15	8	As Shown	100L	N
Efi	*Eucalyptus fibrosa*	Broad-leafed Ironbark	30	8	As Shown	100L	N
Elha	*Eucalyptus moluccana*	Grey Box	20	8	As Shown	100L	N
Small Feature Trees							
Mde	*Melaleuca decora*	White Feather Honeymyrtle	8	3	As Shown	100L	N
Large Shrubs >1.5m height							
BBC	*Banksia* 'Birthday Candles'	Birthday Candles Banksia	1.5	1.5	As Shown	200mm	N
Clsp	*Callistemon citrinus* 'Splendens'	Endeavour Bottlebrush	2	2	As Shown	200mm	N
CMM	*Callistemon* 'Mauve Mist'	Mauve Mist Bottlebrush	2	2	As Shown	200mm	N
Dpu	*Dodonaea viscosa* 'Purpurea'	Purple Hop Bush	2	1.5	As Shown	200mm	N
Emy	*Eriostemon myoporoides*	Long-leaf Wax Flower	1.5	2	As Shown	200mm	N
KRi	*Kunzea ambigua* 'River'	Compact Tick bush	2	2	As Shown	200mm	N
Lfs	*Lambertia formosa*	Mountain Devil	2	1.5	As Shown	200mm	N
Accent Shrubs							
Dev	*Dianyanthus excelsa*	Gymea Lily	3	2	As Shown	200mm	N
Cpe	*Crinum pedunculatum*	Swamp Lily	1.5	1.5	As Shown	200mm	N
Xau	*Xanthorrhoea australis*	Grass Tree	2	1	As Shown	200mm	N
Shrubs <1.5m height							
ACL	*Acacia cognata* 'Limelight'	Bower Wattle	0.8	1.2	As Shown	200mm	N
CLJ	*Callistemon viminalis* 'Little John'	Little John Bottlebrush	0.8	0.8	As Shown	200mm	N
CWA	*Callistemon citrinus* 'White Anzac'	White Anzac Bottlebrush	1	2.5	As Shown	200mm	N
Cal	*Correa alba*	White Correa	1.5	1	As Shown	200mm	N
LPB	*Leptospermum* 'Pacific Beauty'	Pacific Beauty	1.5	2.5	As Shown	200mm	N
Mth	*Melaleuca thymifolia*	Thyme Honeymyrtle	0.8	1.5	As Shown	200mm	N
Tsa	*Thryptomene saxicola*	Thryptomene	1	1.5	As Shown	200mm	N
Mass Planted Grasses & Groundcovers							
Ban	*Brachyscome multifida*	Blain River Daisy	0.15	0.4	6/m2	150mm	N
DLR	*Dianella revoluta* 'Little Rev'	Little Rev Blue Flax Lily	0.3	0.3	8/m2	Tube	N
DPr	*Dianella revoluta* 'Prestige'	Prestige Clumping Flax Lily	0.5	0.8	4/m2	Tube	N
Iro	*Isolepis nodosa*	Knobby Clubrush	1	0.5	4/m2	Tube	N
Jus	*Juncus usitatus*	Tussock Rush	1	0.3	8/m2	Tube	N
LEr	*Lomandra longifolia* 'Emdale'	Emdale Little Lomandra	0.2	0.15	10/m2	Tube	E
Lmu	*Lomandra multiflora*	Lomandra	0.2	0.15	10/m2	Tube	E
LTa	*Lomandra* 'Tanika'	Fine Leaf Lomandra	0.5	0.6	4/m2	Tube	N
Mst	*Microlaena stipoides*	Weeping Grass	0.7	0.5	4/m2	Tube	N
Tau	*Themeda australis*	Kangaroo Grass	0.8	0.3	8/m2	Tube	N
Wgr	*Wahlenbergia gracilis*	Native Bluebell	0.7	0.3	8/m2	Tube	N
Turf							
	Zoysia macrantha 'Nara'	Nara Australian Native Turf					N

Scale: 1:250 @ A3
Scale: 1:100 @ B1

The contractor shall check and verify all work on site (including work by others) before commencing the landscape installation. Any discrepancies are to be reported to the Project Manager or Landscape Architect prior to commencing work. Do not scale this drawing. Any required dimensions not shown shall be referred to the Landscape Architect for confirmation.

Issue	Revision Description	Drawn	Check	Date
B	For Client Review & Comment	PN	GO	01.04.2010
A	For Client Review & Comment	DC	GO	02.03.2010

LEGEND

- LOT BOUNDARY
- PROPOSED BUILDING LINE.
- GARDEN EDGE.
- FENCE TYPE A. (CHAINWIRE FENCE) REFER TO ARCHITECTS DETAILS.
- FENCE TYPE B. (POST & RAIL FENCE) REFER TO ARCHITECTS DETAILS.
- FENCE TYPE C. (STAR PICKET FENCE) REFER TO ARCHITECTS DETAILS.
- INSITU CONCRETE PAVING.
- ROAD PAVING. BY OTHERS.
- LOOSE GRAVEL PAVING.
- EXISTING TREE TO BE RETAINED & PROTECTED.
- EXISTING TREE TO BE REMOVED.
- SHADE AMENITY TREE. REFER PLANT SCHEDULE.
- SMALL FEATURE TREE. REFER PLANT SCHEDULE.
- SHRUB PLANTING. REFER PLANT SCHEDULE.
- ACCENT SHRUB PLANTING. REFER PLANT SCHEDULE.
- GROUNDCOVER & GRASSES PLANTING. REFER PLANT SCHEDULE.
- ECOLOGY ZONE. REFER ECOLOGY REPORT.
- TURF. REFER PLANT SCHEDULE.

SITE IMAGE
Landscape Architects
29 Bowden Street
Alexandria NSW 2015 Australia
Tel: (61 2) 9698 2666
Fax: (61 2) 9699 3977
www.siteimage.com.au
Site Image (NSW) Pty Ltd
ABN 44 001 262 360

Client:
WATER FACTORY COMPANY PTY LTD

Project:
PITT TOWN WATER FACTORY

Drawing Name:
COLOUR LANDSCAPE CONCEPT PLAN

Sheet 1 of 1

PRELIMINARY

Job Number: SS10-2159
Drawing Number: 102
Issue: B

Eucalyptus crebra

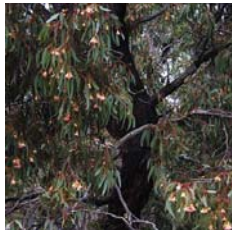
Banksia 'Birthday Candles'

Correa alba

Doryanthus excelsa

Crinum pedunculatum

Lomandra multiflora

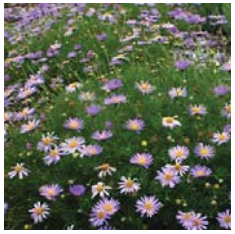


Eucalyptus fibrosa

Callistemon citrinus 'Splendens'

Kunzea ambigua 'Rivan'

Xanthorrhoea australis



Brachyscome multifida

Isolepis usitatus

Melaleuca nodosa

Dodonaea viscosa 'Purpurea'

Thyptomene saxicola

Lambertia formosa

Dianella revoluta

Microlaena stipoides

Melaleuca Decora

Eriostemon myoporoides

Leptospermum 'Pacific Beauty'

Wahlenbergia gracilis

Juncus usitatus

Themeda australis

SITE IMAGE

DRAWING NO: 103
ISSUE: A
DATE: 30.03.2010

CLIENT: Water Factory Company Pty Ltd
ARCHITECT: Morrison Design Partnership
SI JOB NO: SS10-2159

PITT TOWN WATER FACTORY

Planting Palette Images