Wastewater

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Abbreviations and Acronyms

AMT	Australian Meat Technologies
ANZECC	Australian and New Zealand Environment and Conservation Council
AQIS	Australian Quarantine & Inspection Services
BNR	Biological Nutrient Removal
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
d	day
DAF DO EPA	Dissolved Air Flotation Dissolved Oxygen Environment Protection Authority
h	Hour
HRT	Hydraulic Retention Time
HSCW	Hot Standard Carcase Weight *
IAF	Induced Air Floatation
kL	kilolitres
KPI	Key Performance Indicator
LTR	Low Temperature Rendering
mg/L	milligrams per litre
ML	Megalitre
NGR	No Guideline Recommended
NS	Not stated
O&G	Oil and Grease
pa	per annum
SBR	Sequencing Batch Reactor
TSS	Total Suspended Solids
t	tonne
TDS	Total Dissolved Solids
TN	Total Nitrogen
TP TSS	Total Phosphorus Total Suspended Solids
UF	Ultrafiltration
WWTP	Waste Water Treatment Plant

*HSCW = weight of animal - (head + feet + blood + hide + viscera)

Environmental Objectives

- Operate a sustainable, robust and efficient wastewater treatment system.
- Consistently achieve effluent disposal regulatory compliance.

Possible Environmental Impacts

- "Receiving water" impact as a result from effluent disposal, if discharged to a river.
- Soil impact as a result from effluent disposal via land irrigation.
- Odour emissions from wastewater treatment operations.
- Greenhouse gases resulting from biological pond emissions and energy usage for wastewater treatment plant operation.

Key Performance Indicators

	Benchmark Large	Benchmark Small	
Water Usage	10.6	<5	kL/tHSCW
Wastewater Generation	10	3-4	kL/tHSCW
Wastewater Loads			
➢ Phosphorus	➢ 0.34 kgP/tHSCW		
➢ Nitrogen	➢ 2.0 kgN/tHSCW		

- **Large** relates to medium to large integrated export abattoir facilities, processing > 100 t HSCW/day.
- **Small** relates to domestic abattoir facilities processing <50 t HSCW/day.

Further Information

Industry Environmental Performance Review[1]

Current Legislation and Regulation

Commonwealth http://www.ea.gov.au/	• Environment Protection and Biodiversity Conservation Act 1999 • National Environment Protection Council Act 1994
Queensland www.env.qld.gov.au	• Environmental Protection (Water) Policy 1997 • Environmental Protection (Waste Management) Policy 2000 • Water Act 2000 • Water Resources Act 1989 • Integrated Planning Act (1997) • Environmental Protection Act 1994 • Environmental Protection (Waste) Policy and Regulation 2000
New South Wales www.epa.nsw.gov.au	• Local Government Act 1993 • Protection of the Environment Operations Act 1997
Australian Capital Territory www.environment.act.gov.au	• Environment Protection Act 1997 • Environment Protection Regulations 1997
Victoria www.epa.vic.gov.au	• Environment Protection Act 1970 • Melbourne and Metropolitan Board of Works Act 1958 • Planning and Environment Act 1987 • Water Act 1989
South Australia www.environment.sa.gov.au/epa/	• Environment Protection Act 1993 • Development Act 1993 • Sewerage Act 1929 • Water Resources Act 1997
Western Australia www.environ.wa.gov.au	• Environmental Protection Act 1986 • Metropolitan Water Supply, Sewerage and Drainage Act 1909 • Waterways Conservation Act 1976 • Rights in Water and Irrigation Act 1914
Northern Territory http://notes.nt.gov.au/dcm/legislat.nsf	• Waste Management and Pollution Control Act 1998 • Environmental Assessment Act 1994 • Water Act 1992 • Water Supply and Sewerage Services Act 2000
Tasmania www.thelaw.tas.gov.au	• Water Management Act 1999 • Draft Wastewater Management Guidelines for Meat Premises • Environmental Code of Practice for Meat Premises (Slaughtering) 1995 • Environmental Management & Pollution Control Act 1994

Note: The above information is current at the time of publication. It is essential to establish if any subsequent changes or updates have been made.

Environmental Best Practice Overview

Knowledge of Wastewater

- Understand water usage and wastewater sources at the meat processing facility.
- Appropriate monitoring of water usage and wastewater treatment operations.

Wastewater Treatment Design

- Appropriately designed wastewater treatment system for:
  - Receiving environment (i.e. sewer, irrigation, waterway)
  - Scale and seasonality - operating demands and requirements
  - Climate and location (i.e. cold/wet, nearby neighbours)
  - Mixture of plant processes, particularly rendering.

Wastewater Treatment Operation

- Management support.
- Appropriate allocation of resources to operate and maintain systems adequately.
- Contingency planning.
- Monitoring and reporting.

Compliance

- Ensure treated effluent is within regulatory requirements.

Aerial aspect of a Wastewater Treatment Plant

Best Practice Information

The meat industry has to deal with a number of environmental challenges. This includes responsible wastewater treatment and disposal to prevent land and water pollution. A well-designed and managed wastewater treatment system is essential to achieve regulatory requirements and help protect and maintain a sustainable environment.

By focusing on reducing water usage, optimising wastewater treatment and improved waste management, both disposal and treatment costs can be reduced.

The primary aim of this guide is to help achieve environmental best practice guidelines for wastewater treatment in the Australian red meat processing industry and consistently meet the required regulatory standards.

Further Information

- *Eco-efficiency Manual for Meat Processing* [2]
- *Best Practice Wastewater Treatment RPDA* [3]

Best practice wastewater treatment involves:

- Minimising wastewater generation
- Treating wastewater to a standard required for the disposal route chosen
- Monitoring and reporting the treatment system performance
- Increasing recycling and/or reuse to reduce the need for water usage and hence wastewater treatment where regulations and licences permit; and
- Continuous improvement and refinement.

1.0 WATER USAGE

Abattoirs are large users of town water or bore water. Reduction in water usage would have a direct impact on reduced wastewater volumes hence making wastewater treatment and disposal easier and cheaper. Water usage, measured in industry in 2003, currently ranges from 4-18 kL/tHSCW[1] depending on size, product market and export requirements.

Table 1 shows the breakdown (%) of water used in various areas of an abattoir.

Table 1 Water Consumption in an Abattoir

Major Areas of Water Consumption	Percent of Total Fresh Water Consumption
Stockyard (mostly washdown)	7 - 24%
Slaughter, evisceration	44 – 60%
Boning	5 - 10%
Inedible & edible offal processing	7 – 38%
Casings processing	9 – 20%
Rendering	2 – 8%
Chillers	2%
Boiler losses	1 – 4%
Amenities	2 – 5%

The slaughter and evisceration areas are the largest water users and responsible for the majority of cleaning and equipment sterilisation.

The values in Table 1 include water used for daily cleaning and hose-down. Export abattoirs typically use 21-36% of total water use for these purposes. They are required to install a greater number of sterilisers to comply with the high sanitary standards for export.

Food safety regulations stipulate high temperature requirements in certain areas thus 30-40% of water used is either warm (43°C) or hot (82°C).

Further Information

- *For more details on water usage areas refer to Appendix A*
- *Industry Environmental Performance Review*[1]
- *Eco-Efficiency Manual for Meat Processing* [2]
- *Identification of Nutrient Sources, Reduction Opportunities and Treatment Options for Australian Abattoirs and Rendering Plants* [4]

2.0 WASTEWATER CONSITUENTS

Inevitably some blood, fat, manure, meat, paunch and detergents enter the wastewater streams. These wastes contribute to the key constituents, which are described below:

- **Organics** comprising BOD, COD, TSS, oil and grease - are generally biodegradable. If the wastewater is not managed well its degradation by bacteria can cause odours.

- **Nitrogen** (in organic, ammonia and oxidised forms) and **Phosphorous** (typically in the form of organic P or phosphate) are essential nutrients for living organisms. Abattoir effluent contains high levels of both. The degree of treatment required depends on the final disposal route. River disposal requires almost complete removal of both. However only partial reductions in nutrients may be required for land irrigation since they are beneficial for crop growth in sustainable loads.

- **Salt** in effluent comes from animals, water supply and chemical use. Despite high electrical conductivity, only small concentrations of sodium and chloride are normally present, and these are often due to the source water. Care is needed to ensure adequate irrigation areas to achieve long-term environmental sustainability.

- **Micro-organisms** A wide variety of microorganisms are present in untreated abattoir wastewater, including potentially pathogenic microorganisms from animal manure and paunch contents. Many are harmless and assist wastewater treatment.

- **Chemicals** Mainly result from the extensive cleaning and disinfection of the plant on a daily basis. However concentrations are generally low, and do not harm wastewater treatment processes.

- **pH** is typically neutral and **temperatures** can vary from cool to hot in some parts of Australia. High temperatures (greater than 38°C) can enable fats to liquefy and pass through rather than being removed by primary treatment.

- **Toxic compounds and heavy metals** Meat processing wastewater contains negligible amounts of either of these pollutants.

Owing to its composition, abattoir wastewater is very amenable to biological treatment.

Further Information

- *Nitrogen Management Strategy* [11]
- *Identification of Nutrient Sources* [4]
- *Eco-Efficiency Manual* [2]

3.0 WASTEWATER GENERATION AREAS

Generation of wastewater occurs in four main areas, summarised in Table 2. The key aspects of wastewater for treatment are “volume” and “strength”. Volume (kL/day) affects the hydraulic loading and hence efficiency of the wastewater treatment system. Strength (concentration of constituents in the water, mg/L) can impact receiving disposal routes, and hence it’s important to minimise pollutants entering the wastewater streams.

Table 2 Main Wastewater Generation Areas

Facility Area	Flow Volume	Strength
Stockyard	Medium	High
Slaughter / Evisceration	High	Low
Inedible & edible offal processing	Medium	High
Rendering	Low	Very High

Note: The terms low, medium and high are relative, and used in the context of abattoir wastewater streams.

3.1 Manure & Paunch

About 50% of the total phosphorus and sodium contaminants are generated from manure and paunch wastes, which come from stockyard washing, emptying of the animal stomachs and further processing of internal organs. Wastewater from these processes is often combined and referred to as the ‘green‘ stream, and is primary treated separately from the ‘red’ stream. Paunch can be wet or dry dumped and combined with other wastes for composting.

3.2 Slaughter / Evisceration Areas

This “red” waste stream is generated mainly from water used to guarantee modern hygienic practice in the facility, and which becomes contaminated with blood and fats. Blood is the main source of nitrogen followed by urine and proteins from meat scraps. Blood recovery should be maximised and water entering blood containment areas should be avoided.

3.3 Rendering Plants

Rendering, often called the ‘by-products department’, and incorporating blood processing, is responsible for about 60% of COD and 20–40% of the sodium, phosphorus and nitrogen liberated to the wastewater. The major sources of nitrogen, phosphorus and sodium include the raw materials bin drainage and blood processing, whereas COD is primarily sourced from tallow refining. Smaller facilities may not operate a rendering plant. Waste streams from these operations may also be included in “red” streams.

Small amounts of wastewater are generated in other parts of the plant.

Further Information

Details on various areas in a processing plant generating wastewater:

- *Environmental Best Practice Guideline – Introduction to the Red Meat Processing Industry Module*

3.4 Waste Minimisation Strategies

- Minimising waste into the water stream will reduce the wastewater load to the treatment system. This source reduction will have a direct impact on the costs associated with water usage (i.e. treatment and disposal costs).
- It is very important that stormwater be segregated from wastewater streams to the maximum extent possible in order to reduce volumes.
- Appendix A describes waste minimisation strategies for the various wastewater generation areas. Several recent documents assisting in this regard are given in the information box.

Further Information

For more information on how to reduce water usage and waste minimisation strategies known as "Cleaner Production" refer to:

- *Eco-Efficiency Manual for Meat Processing* [2]
- *Water and Waste Minimisation* [5]
- *Nitrogen Management Strategy* [11]
- *EU IPPC BAT Document* [12]

4.0 WASTEWATER DISPOSAL ROUTES

The key disposal routes for treated wastewater (ie effluent) from abattoir operations in Australia include:

1. Sewer
2. Land Irrigation
3. Surface Waters (i.e. rivers, waterways, seaway).

The choice of disposal depends on the location and surrounding environment. An abattoir with nearby residents, no local waterway, inadequate irrigation area and generally wet weather may be restricted to sewer disposal only. Trade waste discharge criteria would need to be met and disposal costs likely incurred, set out by the local authority responsible for managing the sewerage system.

However an abattoir located in a rural area will often dispose via land irrigation and / or to a nearby river. In some instances effluent discharge to rivers continues but is less common due to the high treatment costs associated with the stringent required discharge standard.

Reuse of treated effluent within meat processing plants is typically prohibited for food safety reasons (see Section 5.4.2).

4.1 Effluent Disposal Criteria

Effluent disposal objectives depend on the disposal route and the surrounding environment.

For each disposal route, the effluent must meet the required regulatory disposal standard. These may vary from state to state and are dependant on local and state legislations. The correct effluent disposal criteria should be obtained from the relevant regulatory authority summarised in Table 3.

Table 3 Effluent Disposal Regulation Authority

Disposal Route	Regulation	Authority
Sewer	Discharge concentration / load limits	Local Council
Land Irrigation	Sustainable Loadings	State EPA
Waterway (ie rivers)	Discharge concentration / load limits	State EPA

The state-based discharge limits for each disposal route are shown in Appendix B. Note that these are a guideline only as they were current at the time of print. For current requirements, refer to the appropriate authority.

4.2 Disposal via Sewer

Effluent quality requirements for sewer disposal are stipulated by the local sewerage management authority (ie. Local Council's Trade Waste Authority).

Important factors to be considered include:

- Availability of a nearby sewerage system
- Adequate capacity of the local sewerage treatment plant
- Willingness of the local sewerage authority to accept the effluent under reasonable conditions and at reasonable cost
- Appropriate odour control both on site (i.e. potential close neighbours) and in sewer reticulation
- Appropriate preliminary treatment at the abattoir to meet the disposal criteria
- Annual budget to meet potential head works charges, operating costs and disposal sewer charges.

Small Towns

The most significant factor for disposal of abattoir wastewater to a town sewerage system is the contaminant load (i.e. volume times the strength) in relation to the local town's load production. Abattoirs are large water users and can generate wastewater loads in excess of the town's population.

Large Cities

The basic factor with disposal to sewer in a large city is the cost involved. City sewerage systems treat large volumes and abattoir wastewater is likely to be only a small proportion of the total flow. However it may contain a significant contaminant load, especially with respect to nitrogen. Partially treated abattoir wastewater is likely to be accepted by the sewer management authority, though this may come at a cost.

Sewer charges are rising and the range of parameters that are charged for is increasing. Indicative costs at time of writing these Guidelines can be found in Appendix C.

4.3 Disposal via Land Irrigation

Effluent disposal via land irrigation is the preferred disposal route in rural areas providing sufficient suitable land is available. Providing effluent loadings are sustainable, there are many benefits including nutrient uptake by agricultural produce including stock feed and sustainable tree lots. These can provide a substantial return to the operator.

Disposal Criteria:

Land irrigation is a great example of effluent reuse from the abattoir industry that can be sustainable providing:

- Sufficient area of land, with topography, soils and groundwater conditions suitable for irrigation

- Site available for wet weather storage
- The concentration of salt in the effluent must not be detrimental to the soils at the site or cause a problem elsewhere (i.e. run-off to nearby creek)
- Nutrient loadings must be appropriate to the site and an appropriate management system adopted
- Irrigation Management Plan (IMP) must be implemented.

Due to its importance to the industry, irrigation of wastewater is covered in more detail in the *Environmental Best Practice Guidelines – Effluent Irrigation* module.

Irrigation area for treated effluent

Further Information

For more information regarding irrigation refer to:

- *Effluent Irrigation Manual* [6]
- *Best Practice Wastewater Treatment* [3]

4.4 Disposal via Surface Waters

Surface waters for effluent disposal can be split into two main categories:

- Coastal surface waters (ie estuaries and ocean) and
- Inland surface waters (ie creeks, rivers and lakes).

The requirements for discharge to inland surface waters are much more stringent than coastal surface waters as the potential impact on inland waters is significantly higher.

Important factors to be considered include

- Proximity of the abattoir to a suitable discharge site
- Capital available to build a suitable treatment system
- Space and a management system to deal with the significant quantities of solids generated.

- Annual budget and availability of skilled personnel to operate the system
- Space available for the wastewater treatment system
- Appropriate control of odour from treatment processes.

Disposal Criteria

Historically many abattoirs discharged to surface waters but generally this is not preferred for new plants. This is due to the high treatment costs associated with meeting very strict disposal criteria required in Australia.

The quality of water to be disposed of to surface waters is approaching that of potable water in some inland areas. Testing parasites, pathogens and viruses are becoming a requirement and are generally stipulated by the State Environmental Protection Authority.

Nitrogen and phosphorus in the abattoir effluent may lead to excessive algal and plant growth in the receiving surface waters, particularly if the waters are slow flowing. This requires treatment to a high standard before approval from the regulatory body would be granted.

5.0 BEST PRACTICE WASTEWATER TREATMENT SYSTEMS

Prior to focusing on which wastewater treatment system to use or improve, one should focus on wastewater reduction (ie reduction in water use and waste minimisation and separation).
Remember to consider:

- **Avoid waste production**
- **Reduce water use**
- **Recover wastes**
- **Reuse / Recycle water***
- **Treat and Dispose (last option)**

*** "Quality needs to meet strict food safety requirements and regulations"**

5.1 Factors Affecting Your Decision

By now you should have a good idea on what disposal route or routes you have available and what quality is required for disposal. The next step is to consider the following:

- Space available
- Nearby neighbours (i.e. sensitive to odours, noise)
- Current treatment system
- Site resources and skills to manage system
- Available capital and operating budget
- Before a final system is selected, advice from a wastewater specialist is advisable
- In general, some form of treatment will be required prior to disposal.

5.2 Best Practise Wastewater Treatment in Australia

There are three key wastewater treatment levels that generally need to be considered. Functions of each are described in Table 4. Detailed descriptions, and the advantages and limitations of the various technologies are summarised in Table 11.

Table 4 Typical Extent of Treatment for Disposal Routes

Treatment Level	Main Goal	Disposal Route
Primary	Remove coarse and suspended solids, oil and grease	All, may use advanced primary for sewer.
Secondary	Remove nutrients, organics and pathogens	Irrigation, waterways, possibly sewer.
Tertiary	Disinfection	Possibly waterways, irrigation and reuse.

5.2.1 Best Practice Wastewater Treatment for Sewer Disposal

Effluent disposal via sewer is best suited to generally larger abattoirs located close to residents. Smaller abattoirs maybe challenged with more stringent trade waste agreements.

Best practice wastewater treatment to minimise trade cost charges and comply with trade waste regulations will generally consist of:

- Oil and grease removal
- Suspended solids and BOD reduction
- Monitoring and reporting is typically conducted by the trade waste authority
- Contingency planning as required
- Ensure effective personnel training.

Best practise wastewater treatment systems for sewer disposal are summarised in Table 6 with considerations highlighted in Table 5.

Table 5 Sewer Disposal Treatment System Considerations

Considerations	Treatment option is dependant on	Watchouts
• Trade waste agreement - effluent quality disposal requirements and trade waste charges. • Cost benefit analysis of trade waste charges vs advanced on-site treatment system costs. • Disposal of solids from treatment processes. • Odour management.	• Size of town (small vs large). • Available space on site – extensive of compact. • Nutrient removal requirements. • Any nearby residence – odour management. • Size of town's sewerage treatment system.	• Trade waste requirements can vary significantly – dependant on local authority. • Trade waste requirements are often more stringent in smaller towns due to abattoir's significant load on local wastewater treatment plant. • Impact of future changes in regulations and charges.

Further Information

- *Environmental Best Practice Guidelines – Odour and Air Quality*
- *Environmental Best Practice Guidelines – Waste Solids*

Hydrocyclone

Table 6 Best Practice Wastewater Treatment Systems – Disposal via Sewer

Treatment Type	Current Proven Technology	Comments
Physical (gross solids and fat removal)	Screening (static, vibrating, rotary) Baleen Screw Press Hydrocyclones Savealls Dissolved Air Flotation (DAF) Induced Air Flotation (IAF/CAF)	Screening is essential for coarse solids removal and protection for downstream processes. Rotary screens are common, static are effective for green streams. Savealls, IAF/DAF and hydrocyclone are used for oil and grease and suspended solids reduction. Effluent may be suitable for direct discharge to sewer or for subsequent biological treatment. Green and red streams may be handled separately. High temperatures affect the efficiency of treatment. All technologies generate solid sludge or fatty floats which are unstable and require disposal.
Chemical Treatment	Chemical precipitation (pre-treatment or biologically treated effluent) Electrocoagulation	Must be used in conjunction with solids collection technology, such as DAF or IAF. Common for sewer discharge. Commonly flow paced dosing controls dosing with influent rate. Generates very large sludge quantities. Electrocoagulation may be used on strong streams.
Pond based	Anaerobic Ponds Aerated Ponds Facultative Ponds	Green and red streams combined prior to biological treatment. Common first stage for cost-effective organic load reduction and may produce effluent suitable for discharge to sewer. Uncommon in urban situations, since large area required. Odours can be an issue but can be overcome by installing natural crust covers,. synthetic covers (which remain unproven in large scale operations) or, rarely, covers with gas collection and flaring. Commonly used downstream of anaerobic systems Although requiring less land area, involves more power for aerators. Increased sludge. Less risk of odour emission. Achieve some nitrogen reduction. Effluent suitable for discharge to sewer. Produces effluent suitable for sewer discharge, but require larger land area than ponds above.
Biological Treatment	Activated Sludge Trickling filtration	Generally not used as produce effluent quality much better than sewer standard requirements. Used if TP or TN removal required.

5.2.2 Best Practice Wastewater Treatment for Irrigation Disposal

Effluent reuse via land irrigation is best suited to small abattoirs located in dry areas. However many large abattoirs that have access to large irrigation or crop areas use it successfully. It is important to ensure soils are suitable otherwise long term environmental impacts can occur.

Best practice wastewater treatment will generally consist of:

- Solids and grease removal
- Biological reduction of organic, nutrient and pathogen levels
- At least 6-monthly monitoring of final water quality and associated reporting
- Contingency planning to cover high-consequence events
- Ensuring effective training and resourcing of operating personnel.

For small abattoirs, or where the climate is dry and neighbours distant, effluent may be irrigated with little more than primary treatment to reduce fats and solids. However where wet-weather storage is required, or the abattoir size dictates it, some biological treatment will be needed.

Table 7 Irrigation Disposal Treatment System Considerations

Considerations	Treatment option is dependant on	Watchouts
• Soil is suitable for nutrient and hydraulic uptake. • Sufficient land area. • Wet weather storage requirements. • Sustainable loadings of nutrients and water. • Groundwater vulnerability. • Disposal of solids from primary and secondary (if needed) systems.	• Nutrient removal requirements for sustainable loadings to land. • Any nearby residence – odour management.	• Solids, algae and fats blocking irrigation system. • Odours from inadequately treated wastewater from storage dams. • Effluent quality doesn't degrade the environment long term (i.e. salts, nutrients). • Don't over-irrigate

Anaerobic pond with a naturally formed crust

Table 8 Best Practice Wastewater Treatment Systems – Disposal via Irrigation to Land

Treatment Type	Current Proven Technology	Comments
Physical (gross solids and fat removal)	Screening (static, vibrating, rotary) Baleen Screw press Hydrocyclones Savealls Dissolved Air Flotation (DAF) Induced Air Flotation (IAF/CAF)	Screening is essential for coarse solids removal and protection for downstream processes. Rotary screens are common, static are effective for green streams. Savealls, IAF/DAF and hydrocyclone are used for oil and grease and suspended solids reduction prior to irrigation. Green and red streams may be handled separately. High temperatures affect the efficiency of treatment. All technologies generate solid sludge or fatty floats which are unstable and require disposal.
Chemical Treatment	Chemical precipitation (pre-treatment or biologically treated effluent) Electrocoagulation	Must be used in conjunction with solids collection technology such as settling tank, DAF or IAF. Rarely used for effluent irrigation due to high volumes of sludge produced. Electrocoagulation may be used on strong streams.
Pond based	 Anaerobic Ponds Aerated Ponds Facultative Ponds	Green and red streams combined prior to biological treatment. Common first stage for cost-effective organic load reduction. Odours can be an issue, but can be overcome by installing natural crust covers,.synthetic covers (which remain unproven in large scale operations) or, rarely, covers with gas collection and flaring. Commonly used downstream of anaerobic systems Although requiring less land area, involves more power for aerators. Increased sludge. Less risk of odour emission. Achieve some nitrogen reduction. Produces effluent suitable for effluent irrigation where nutrient removal is not needed. A downstream maturation pond is typically used to provide some disinfection of effluent prior to irrigation.
High rate Biological Treatment	Activated Sludge	Only used if TP or TN removal required. Typically SBR format.
Land Based	Wetlands	Used as final polishing step. Vulnerable to overloading.
Disinfection	Maturation Pond Chlorination	Most common form of disinfection, provided organic loading is low. Typically recommended where third party irrigation reuse is considered.

5.2.3 Best Practice Wastewater Treatment for Surface Water Disposal

Modern limits for surface water discharge are stringent and require extensive and a highly robust wastewater treatment plant capable of consistent effluent quality regardless of the abattoir operating cycle.

Best practice wastewater treatment will typically include:

- Solids and grease removal
- High efficiency organic and nutrient removal
- Disinfection to at least secondary contact level
- At least weekly monitoring and reporting of system performance
- High degree of contingency planning
- Ensuring effective training and resourcing of operating personnel.

Table 9 Surface Water Disposal Treatment System Considerations

Consideration	Treatment option is dependant on	Watchouts
• Receiving water effluent quality and/or load requirements. • Seasonality impacts on receiving water (eg flows). • Capital and operating costs of plant, especially operating personnel requirements. • Monitoring equipment. • Impact of plant operating cycle (especially shut-down, weekend closure) on treatment performance. • Disposal of biosolids.	• Nutrient removal requirements.	• Operating personnel training. • Biosolids capture and treatment – can be expensive. • Restriction on disposal of chemical sludges.

Sequencing Batch Reactor

Table 10 Best Practice Wastewater Treatment Systems – Disposal via Waterways

Treatment Type	Current Proven Technology	Comments
Physical (gross solids and fat removal)	Screening (static, vibrating, rotary) Baleen Screw press Hydrocyclones Savealls Dissolved Air Flotation (DAF) Induced Air Flotation (IAF/CAF)	Screening is essential for coarse solids removal and protection for downstream processes. Rotary screens are common, static are effective for green streams. Savealls, IAF/DAF and hydrocyclone are used for oil and grease and suspended solids reduction prior to further treatment. Green and red streams may be handled separately. High temperatures affect the efficiency of treatment. All technologies generate solid sludge or fatty floats which are unstable and require disposal.
Chemical Treatment	Chemical precipitation (pre-treatment or biologically treated effluent) Electrocoagulation	Must be used in conjunction with solids collection technology such as settling tank, DAF or IAF. Chemical dosing of DAF may be used for organic load reduction rather than using anaerobic ponds. May be used for phosphorus removal. Electrocoagulation may be used on strong streams.
Pond based	Anaerobic Ponds Aerated Ponds Facultative Ponds	Common first stage for cost-effective organic load reduction. Odours can be an issue, but can be overcome by installing natural crust covers, synthetic covers (which remain unproven in large scale operations) or, rarely, covers with gas collection and flaring. Not used – effluent quality unsuitable for waterways discharge. Not used – effluent quality unsuitable for waterways discharge.
High rate Biological Treatment	Activated Sludge	Used to achieve organic and nitrogen reduction. SBRs tend to be preferred configuration. Waste biosolids require dewatering and disposal Biological phosphorus removal has yet to be demonstrated at full scale.
Disinfection	Chlorination UV disinfection	Remains most reliable and effective technology. Rarely used due to poor transmissivity of effluent.

5.2.4 Effluent Reuse

Effluent reuse opportunities are being considered in Australia in a bid to reduce water consumption. However strict regulations and food safety standards, such as the EU international standards that specifically affect export facilities, prohibit the reuse of water even for non-product contact areas such as stockyard washdown.

The use of potable water and non-potable water in export abattoirs is controlled rigidly by the Export Meat Orders. They stipulate that there must be two separate plumbing systems for potable and non-potable water and that non-potable plumbing is labelled clearly as such.

It is highly unlikely that overseas customer countries, particularly Japan and the United States of America, will approve the direct or indirect use of recycled water in food plants.

Within the limits above, areas where non-potable water could be used include:

General Site Operations

- Cooling tower makeup
- Boiler make up
- Outdoor paved area cleaning
- Watering of landscaped areas
- Cattle truck washing.

Abattoir Operation

- Stockyard washdown
- Inedible offal processing
- Cleaning around wastewater treatment plant
- Cleaning sprays for screens at wastewater treatment plant
- Initial washing of cattle prior to slaughter (followed by a potable water wash).

Tertiary treatment of effluent using dissolved air flotation cell

Table 11 Wastewater Treatment Systems

Process	Photo	Description	Advantages	Limitations
PRIMARY TREATMENT				
Static and Vibrating Screen		Screening removes the solid material from the wastewater. The liquid is separated from the solids by gravity, water action and mechanical forces.	Screens are robust, strong and easy to maintain. There is no electrical energy or mechanical parts needed for static screens. In vibrating screen there is a lower moisture content and solids less easily block the screens.	The screens must be periodically cleaned to avoid solid build up. Screens are not suitable for fat laden material. Static screens have more binding problems than vibrating screens and are more labour intensive to clean. Vibrating screens are susceptible to mechanical failure.
Rotary Screen		Rotary screens are rotating cylindrical wire screens. Effluent typically enters in the centre, with solids discharged at the other end.	Rotary screens are easily cleaned and can handle flow surges. They have a better efficiency than other types of screens for fatty effluent.	There is a risk of mechanical failure as high fat loading or the presence of fibrous solids may bind the screen. The screen requires regular cleaning. The solids removal is limited to screen aperture or staining capacity of accumulated solids.
Screw press		Combines a screen with screw auger to produce dry solid discharge.	Effective for screening and produce better dewatered solids (lower moisture content) compared to screens – important where solids must be taken off-site	High wear and may release more contaminants to wastewater.

Process	Photo	Description	Advantages	Limitations
Hydrocyclones		Uses centrifugal force to separate solids or fats in a conical separator with no moving parts.	Small footprint and HRT. Fat removal less affected by high temperatures.	Need to install a pump. Vulnerable to blockage from fine solids and fat.
Save all		A saveall is a tank that allows floatable material to rise to top of the tank and settled solids to sink.	Saveall are cost-effective for reliable removal of fat. The fat that is removed can become a useful by product. Save all also allows for easy solids removals.	At maximum flow and elevated temperatures savealls operate at low efficiency. Odour can be a problem and mechanical scrapers are not always reliable. The save all is not as effective as a DAF system. Require large footprint.
Electro-coagulation		Uses iron of aluminium dosing in combination with electrical field to remove contaminants.	Highly effective on low volume, high strength streams. No dosing equipment. Removes phosphorus.	Unproven in dilute, high volume streams. Generates high volumes of unstable solids.
Dissolved Air Flotation (DAF)		Wastewater is pressurised then saturated with air. Once the pressure is released solids and fat are floated and removed Chemicals can be added to assist removal. These include; acid, alum, ferric chloride lime, polyelectrolyte and aluminium chloride.	Chemical DAF can effectively remove fats, solids, BOD, nitrogen and phosphorus. Non-chemical DAF is still very efficient in the removal of fats. Reliable, with a small footprint. Best operation when use DAF effluent recycle for air saturation.	Vulnerable to poor fat removal at temperatures above 39°C. Generate low solids, unstable float. Chemical dosing generates high sludge volumes.

Process	Photo	Description	Advantages	Limitations
Induced Air Flotation (IAF) or Cavitation Air Floatation (CAF)		The difference between IAF and DAF is with IAF the bubbles are created by using a pump or venturi system. The bubbles that are internally formed are larger but fewer in number,	Simpler than a DAF. IAF needs no air compressor or recycle pump. It requires lower energy than the DAF and is more efficient than a saveall.	The IAF is less reliable than the DAF. It is difficult to control the amount of air saturation.
BIOLOGICAL TREATMENT				
Aerated Pond		Achieves microbial breakdown of organic material under aerobic conditions. Air provided mechanically, usually by surface aerators.	Reliable, simple to use and have a low odour risk. Good BOD removal. Can achieve high nitrogen removal if required.	Large footprint. Power supply required for aerators. Effluent will have high concentration of suspended solids.
Anaerobic Pond • Natural Cover • Synthetic Cover		Achieves microbial breakdown of organics to mainly gas in absence of oxygen	Simple and easy to construct. They can handle variations in the load of wastewater. Usually form a crust which minimises odour emission. Low sludge formation. Highly cost effective organic removal.	Odour and greenhouse gas emissions. Effluent unsuitable for release to environment.
Facultative Ponds		Combine anaerobic and aerobic breakdown of organics.	Reliable, low maintenance, simple.	Need a large area. There can be algal blooms in some cases and the ponds can be easily overloaded. Seasonality will affect performance.

Process	Photo	Description	Advantages	Limitations
Maturation Pond		Shallow ponds which are highly aerobic	Reliable, low maintenance, simple Achieve disinfection	The limitations of maturation ponds are the same as facultative ponds.
Activated Sludge		An intensified aerated pond, operates by recycling sludge to maintain high bacterial levels. Either continuos flow (using a clarifier at the end) or intermittent (SBR) forms.	Rapid, versatile treatment. Generates very high quality effluent	Expensive to build and operate. Vulnerable to upset, especially where loads are uneven or high in fat. Care needed in shutdowns.
BNR		Refers to use of activated sludge to remove nutrients	Only demonstrated technology capable of cost-effective nitrogen removal, SBR systems are cheaper and more flexible than continuous systems.	
Wetlands		A complex system consisting of plants in a shallow soil matrix. Alternative to maturation ponds.	Suited to specific sites but specialised planning is required. Achieve high suspended solids and pathogen removal. Highly biodiverse.	Lack of design parameters for abattoir effluent. Feed concentrations need to be low. Unpredictable and variable final effluent quality. Large areas required and lack of control during periods of wet weather or floods. Sludge build up over time.

Process	Photo	Description	Advantages	Limitations
TERTIARY TREATMENT				
Chlorination		Chlorination involves adding either chlorine gas or sodium hypochlorite solution into the water to kill microorganisms.	Simple, cost effective, reliable and proven technology. It removes some of the colour from water and is effective against bacteria.	Chlorine can be toxic to wildlife and form THM by-products. It is inappropriate for high ammonia concentrations and is both temperature and pH dependent.
Ultraviolet Irradiation		In ultraviolet irradiation the wastewater is exposed to ultraviolet rays.	UV is more effective in treating viruses than most other disinfection methods. It is chemical free thus is non hazardous. It is rapid and does not require much space.	In order to stop the UV tubes from fouling and decreasing efficiency, regular cleaning and replacement is required. UV irradiation is less effective at high turbidity.

5.3 Best Practice Operational Tips

One of the first steps in meeting wastewater treatment standards is the optimisation of current treatment facilities such as screening, saveall and DAF. Operational tips can help optimise the process and reduce costs. Operating tips are described in Table 12.

Table 12 Operating Tips for Treatment Systems

Treatment Type/System	Operational Tips
General	• Floor drains, sumps and save-all systems should be kept free of accumulated solids and crusts • Uncontaminated storm water should be excluded from the waste treatment areas • Contingency planning – procedures and stand-by equipment available for accidents or equipment failure • SHEEPSKIN/HIDE PRESERVATION - Preference is of dry salting of skins with dryclean. Where brine is formed keep separated from wastewater stream and dispose of in a sustainable manner
Screens	• Screening surface kept clean • Ensure solids drainage zone free of water • Regular emptying of solids bin (don't let the bin fester) • Minimise aerosols.
Saveall	• Ensure regular cleaning of Saveall area • Regular maintenance (eg. Rubber strips in good condition of scrappers for float and/or collection) • Regular solids removal from bin (don't let the bin fester)
DAF	• Best working temperature <38°C for fat removal • Regular inspection and maintenance of air diffusers • Watch sludge buildup and check air bubble size • Where chemical dosing, ensure dosages are correct
Anaerobic Ponds	• Maintain good crust cover (100%) on pond • Ensure discharge to subsequent treatment units is submerged to minimise odour emissions • Ensure temperature <40°C
Facultative Ponds	• Ensure regular monitoring • Watchout for rising up-dwellings of black sludge (indicates pond has become anaerobic) • Loss of dissolved oxygen concentrations • Monitor pond capacity (eg Depth sludge)

Treatment Type/System	Operational Tips
Monitoring and Reporting	• Weekly visual inspections for systems to sewer or land; daily for system to surface water • Record water usage and flows • Measure pH, temperatures in DAF and anaerobic ponds • Sample and analyse relevant contaminant concentrations routinely

6.0 REFERENCES

1. Meat and Livestock Australia, 2005, *Industry Environment Performance Review in 2003*, Project PRENV 033, Sydney, Australia.
2. Meat and Livestock Australia, 2002, *Eco-Efficiency Manual for Meat Processing*, Sydney, Australia.
3. Meat and Livestock Australia, 1998, *Best Practice Wastewater Treatment* RPDA.308B, Sydney, Australia.
4. Meat Research Corporation, 1995, *Identification of Nutrient Sources, Reduction Opportunities and Treatment Options for Australian Abattoirs and Rendering Plants*, Summary (M.445), Sydney, Australia.
5. Australian Meat Technology, 1995, *Water and Waste Minimisation*, McBenny Publishers.
6. Meat and Livestock Australia, 1996, Effluent Irrigation Manual, M.467, Sydney, Australia.
7. University of Queensland and CSIRO, *Abattoir Waste Water & Odour Management*, Hans Quality Print.
8. Prepared by EC Pacific Pty Ltd, February 2003, *Evaluation of a Full-scale Electrocoagulation Process for Abattoir Effluent Treatment*, Final Report.
9. Prepared by the Department of Chemical Engineering, University of Queensland, December 1997, *Nutrient removal from abattoir wastewater* (M.478), Meat and Livestock Australia.
10. McConnell. S, May 2004, *Code of Environmental Best Practice for Viticulture – Sunraysia Region*, Volume 1, Department of Primary Industries.
11. Prepared by Uniquest Pty Ltd, August 2003, *A Nitrogen management strategy for meat processing plants*, PRENV.012, Meat and Livestock Australia.
12. EU Commission Sept. 2003 *Draft Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries,* Seville.

APPENDIX A

Water Usage, Wastewater Sources and Types of Contamination Found at Abattoirs

Area of Process	Activity	Water Usage [a] (kL/day)	Types of Contamination	Waste Minimisation Strategies
Stockyard	Stock watering Stock washing Wash down of stockyard Truck washing	10 70 130 40 **25%**	Soil and bacteria from washing cows. Hair	Pre wash dirty cattle. Ensure all equipment is correctly designed and maintained. Have a suspended mesh floor in the stockyards. Before the wastewater from the stockyards enters the existing effluent system it should be screened for solids. Use recycled water for wash down and stock washing.
Slaughter Floors	Viscera table wash sprays Head wash Carcase wash Carcase splitting saw	60 3 40 1 **10%**	Blood Tissue Fat Detergents Disinfectants	Collect blood into a blood pit. When collecting blood off the floor do not use a hose, instead use a squeegee. Set a standard blood recovery. Keep water pressure at a minimum during carcass washing. Remove all visible contamination by trimming. Always preform dry cleaning before wash down of the facilities. Wash equipment before sterilisation. Turn water streams off when not in use. Select high impact, low flow nozzles. Low temperature water stream for carcase washing. Ban hoses in blood pit.
Paunch, gut and offal washing.	Paunch dump and rinse Tripe/Bible washing Gut washing Edible offal washing	80 30 60 30 **20%**	High BOD High nutrient waste	Collect all solids. Use knee or thigh high-operated valves in the water line. Use dry dumping of paunch material. Any liquid residue from paunch dumping should be treated with the effluent from the rendering plant. Use immersion washing. Use recycled water from the slaughter floor, carcase washing and hand wash basins to clean the inedible products.
Rendering	Rendering separators	10	Nitrogen	Drainage liquid from raw material conveyor and bins should be

	Rendering plant washdown	5 **2%**	Phosphorus Salt BOD Paunch liquid Condensate from a dry rendering operation. Stick water from decanter centrifuges. Stick water from blood coagulation. Tallow wash water from polisher centrifuge.	passed through rendering plant. Wastewater streams should be kept separate from the other wastewater sources in the plant. Little opportunity to reduce overall water usage.
Plant Washing Sterilisers and wash stations Amenities Plant cleaning Plant services	Knife sterilisers Equipment sterilisers Hand wash stations Exit /entry hand, boot and apron wash stations Personnel amenities Wash down during shifts Cleaning and sanitising at end of shift Washing tubs, cutting boards and trays Condensers Cooling tower makeup Boiler feed makeup	60 20 20 **10%** 40 25 **7%** 20 170 30 **22%** 20 10 10 3 **4%**	Blood Trimmings Damaged Cartons Polystyrene Strapping Polyethylene	Wash down should always be preceded by dry cleaning. Correctly separate solid waste from wastewater Limit water pressure and volume. Use belt conveyers to collect trimmings and fats in boning room. Install trays to capture bone dust under boning tables. Order of washing; stands, walls then floors.

Note: This data is an example breakdown of water usage in meat processing. It is based on a ‘typical meat plant’ which is defined as a plant processing the equivalent of 150 tonnes Hot Standard Carcase Weight (HSCW) per day, which is equivalent to 625 head of cattle per day, based on a conversion rate of 240 kg/head. Water usage can vary considerably from one plant to another, so this should be regarded as an example only.

APPENDIX B
Australian Discharge Limits

Table B1 Sewer Disposal Pollutant Limits

Parameter	Unit	National (ANZECC)	New South Wales	Queensland	South Australia	Victoria	Western Australia
BOD	mg/L	site specific	300[a]	Limits set by individual Councils, generally based on ANZECC criteria.	site specific	Limits set by individual Water Authorities, generally based on ANZECC criteria.	< 3000
COD	mg/L	site specific	< (3 x BOD)		site specific		< 6000
Suspended solids	mg/L	site specific	NS		< 1000		< 1500
Temperature	C	< 38	< 38		< 38		< 38
pH	-	6.0 - 10.0	7.0 - 9.0		6.0 - 10.0		6.0 - 10.0
Oil and grease	mg/L	< 200	< 50[b]		< 100		NS
Ammonia as nitrogen	mg/L	< 100	< 50		< 50		< 200
Kjeldahl nitrogen	mg/L	< 150	< 100		NS		NS
Total phosphorus	mg/L	< 50	< 20		NS		NS
Sulfate	mg/L	< 2000	< 100		< 1500		NS
Chlorine	mg/L	< 10	< 10		< 5		< 10
TDS	mg/L	NS	< 4000		NS		NS

Notes:

(a) Higher values (< 600 mg/L) may be acceptable if sufficient capacity at treatment plant and dilution in sewer is available

(b) Higher values (< 100 mg/L) may be acceptable if volume of the discharge is less than 10% of the capacity of the treatment plant

NS = Not specified

Table B2 Surface Water Disposal Pollutant Limits

Parameter	Unit	National (ANZECC)	New South Wales[b]	Queensland	South Australia[d]	Victoria		Western Australia[c]
		Secondary Contact	90% ile	Refer to ANZECC criteria[c]		median	90 %ile	Secondary Contact
BOD	mg/L	NGR	10		<6	5	10	NGR
Suspended solids	mg/L	< 10% change[a]	15		< 10% change	10	15	< 10% change[a]
pH	-	5.0 - 9.0[a]	6.5-8.5		6.5 - 8.5	6 - 9		5.0 - 9.0[a]
Ammonia as nitrogen	mg/L	0.02 - 0.03[a]	2		Refer to National Guidelines	2.0	5.0	0.02 - 0.03[a]
Total nitrogen	mg/L	0.1 - 0.75[a]	10			10	15	0.1 - 0.75[a]
Total phosphorus	mg/L	0.01 - 0.1[a]	0.3			0.5	1.0	0.01 - 0.1[a]
E.coli	org/100 mL	< 1000	200		150 (primary contact)	200	1000	< 1000
Oil & Grease	mg/L	(e)	2		15 maximum 8 average	non visible		(e)
TDS	mg/L	500[f]	NS		NS	NS		NS

(a) Criteria relates to receiving water, ie after mixing

(b) Source: NSW EPA Submission to Public Inquiry into Management of sewage and sewage by-products in the coastal zone (Table 1, Appendix 3)

(c) Site specific (dependent on environmental value of receiving water body and characteristics of effluent)

(d) Environment Protection (Marine) Policy 1994 - South Australia

(e) Oil should not be noticeable as a visible film on the water nor should be detectable by odour

(f) Based on limits required for good quality drinking water

NGR = No Guideline Recommended

NS = Not Stated

APPENDIX C
Trade Waste Charges & Discharge Factor

Charges Levied on High Strength Trade Waste Generators

	Year	Permit Fee ($/annum)	Flow ($/kL)	BOD ($/kg)	COD ($/kg)	SS ($/kg)	O&G ($/kg)	TKN ($/kg)	TP ($/kg)	Sulphate ($/kg)
QUEENSLAND										
Brisbane (Category D)	2003/04	Min $240.00	$0.43	$0.97-$1.14		$0.48		$0.43	$0.71	
Bundaberg (Category 3)	2003/04	$336.00	$0.84	Unit charges are based on the actual cost to treat the pollutant over the cost to treat domestic sewage concentration						
Caboolture (Category 3)	2003/04	$158.00	$ 0.52	$1.45		$0.38				$0.34
Cairns (Category 3)	2003/04	$169.00	$0.52	$0.88		$0.57				
Caloundra (Category 3)	2003/04	n.a.	$1.31	$0.66		$0.56	$0.56			
Emerald (Category 3)	2003/04	$50.00	$ 0.68		$0.70	$0.50				
Gold Coast (high strength)	2003/04	Nil	$1.00		>1,000mg=$1.00	>300mg=$0.64			>10mg=$7.87	
Ipswich (Category 3)	2003/04	$480.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Logan (Category 3)	2003/04	Min $196.00	$0.50	$0.60	$0.37	$0.69	$0.57	$0.57	$0.57	$0.57
Mackay (Category 3)	proposed	$100.00	n.a.		$0.40	$0.75		$2.01	$3.18	
Mareeba (Category 3)	2003/04	n.a.	n.a.		$0.40	$0.55				
Maroochy (Category 3)	2003/04	$64.70	$0.50	$0.93	$0.44	$0.60	$0.60			
Maroochy (high strength)	proposed	Nil	$1.70		>600mg=$0.50	>300mg=$0.87		>80mg=$1.50	>15mg=$3.60	
Noosa (Category 2)	n.a.	$250.00	$0.50	$0.50		$0.50		$1.00	$1.00	
Pine Rivers (Category 3)	2003/04	$80.00	$0.57	>300mg=$0.94	>600mg=$0.81	>300mg=$0.76	>200mg=$0.47	>80mg=$0.59	>40mg=$0.47	>100mg=$0.83
Redland (Category 2)	n.a.	$153.50	$0.80	$0.77	$0.77	$0.35	$0.35			
Rockhampton (Category 3)	2003/04	$150.00	$ 0.40	$0.80		$0.95				
Toowoomba (Category 3)	2003/04	Min $270.00	0-5ML=$0.26 >5ML$0.36	$0.36		$0.41	$0.55	$0.84	$2.80	
Townsville (Category 3)	2003/04	Min $161.44	$0.64	$1.39		$1.61				
Townsville (Category 2)	proposed	Min $203.00	$0.78		$0.73	$0.61				$0.30
NEW SOUTH WALES										
Ballina (Category 2b)	2003/04	Nil	$0.83	>300mg=$1.13	>900mg=$0.35	>300mg=$0.78	>50mg=$1.95			
Bathurst (Category A)	2003/04	$451.10	$0.52	$0.64		$0.50	$1.28			
Coffs Harbour (Category 3)	2003/04	$130.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hastings (Category 3/4)	2003/04	Nil	$0.45	$0.80		$0.70	$1.60			
Hunter (Major)	2002/03	$367.83		$1.80		$1.80		$3.60		$0.10xactual^2/2000
Gosford	2003/04	n.a.	$0.20	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)	$1.30/kL (each 1,000mg)
Shoalhaven	2003/04	$150.00	$0.90	$0.88		$0.67	$0.88			
Sydney (as per risk index)	2003/04	As per risk	n.a.	$0.66xactual/60		$0.71	$1.00	$0.14	$1.11	$0.11xactual/2000

		index		0						
Tweed	2003/04	Nil	$0.65	300-600mg=$0.16 600-900mg=$0.64 900-1200mg=$0.96 1200-1500mg=$1.28 1500-1800mg=$1.60 1800-2100mg=$1.94 2100-2400mg=$2.24		300-600mg = $0.21 600-900mg = $0.84 900-1200mg = $1.26 1200-1500mg = $1.68 1500-1800mg = $2.10 1800-2100mg = $2.57 2100-2400mg = $2.94	50-100 = $0.05 100-150 = $0.20 150-200 = $0.30 200-250 = $0.40 250-300 = $0.50			

VICTORIA										
Barwon	2003/04	As per risk index	$0.89	>500mg=$0.29		>500mg=$0.09		>50mg=$0.32		$0.48
City West (Category 3)	2003/04	0-2.5ML=$225.00 2.5-25ML=$675.24 25-100ML=$2,250.96 >100ML=$6,753.36	$0.36	$0.39		$0.19		>50mg=$0.74		100-500mg=$0.82 >500mg=$1.16
Goulburn Valley (Category 3/4)	2003/04	$100.00	$ 0.30	$0.20				$0.30	$0.80	
South East (Category 3)	2003/04	$225.00-$6753.44	$0.36	$0.39		$0.19		>50mg=$0.74		100-500mg=$0.82 >500mg=$1.16
South West (Category 3)	2003/04	Nil	Specified in individual trade waste agreements							
Yarra Valley (Category 3)	2003/04	Nil	$0.36	$0.39		$0.19		>50mg=$0.74		100-500mg=$0.82 >500mg=$1.16
WESTERN AUSTRALIA										
Water Corporation	2003/04	$159.00	$0.98	0-5,000mg=$0.85 >5,000mg=$1.70		0-2,000mg=$0.80 >2,000mg=$1.60	0-300mg=$0.38 300-600mg=$0.76 >600mg=$1.53	$0.24	$0.26	>50mg=$0.40
AVERAGE		**$1,000.00**	**$0.60**	**$0.80**	**$0.65**	**$0.70**	**$0.85**	**$0.95**	**$2.00**	**$0.60**

Source: assorted service providers

APPENDIX D
Glossary of Terms

Aerobic	biological treatment processes that occur in the presence of oxygen
Anaerobic	biological treatment processes that occur in the absence of oxygen
Best Practice	practices adopted by an organisation that are considered the most effective at achieving the desired outcome within reasonable technical and economic restraints
Biochemical Oxygen Demand	the amount of oxygen utilised by micro-organisms in the process of decomposition of organic material in wastewater over a period of 5 days at 20°C
Chemical Oxygen Demand	a measure of oxygen required to chemically oxidise organic matter in wastewater
Chlorination	the chemical dosing of chlorine for disinfection
Cleaner Production	involves the management of environmental impacts of an organisation or process while improving the economic efficiency of the process
Dissolved Oxygen	A measure of oxygen concentration dissolved in water
Dissolved Solids	salts dissolved in wastewater
E. Coli	one of the coliform bacteria population and is a measure of faecal origin
Effluent	wastewater outflow after one or more stages of treatment
Electrical Conductivity	A measure of the ability of the water to conduct an electrical current. Conductivity is sensitive to dissolved solids and is a good indication of increased inputs of these compounds.
End-of-Pipe	The process of cleaning up wastes once they have been generated
Environment	surroundings in which an organisation operates including air, water, land, natural resources, flora, fauna, humans and their interrelation
Facultative	biological treatment processes in which both aerobic and anaerobic environments exist
Faecal Coliforms	general term for the bacteria produced from the gut of warm blooded animals (used as an indicator of faecal pollution)
Flocculation	involves the physical aggregation of particles, usually by chemical dosing, and subsequent floc formation
Kjeldahl nitrogen	the Kjeldahl test determines the quantity of organic nitrogen and ammonia present in the wastewater

Non-potable	water which can not be used for drinking purposes
Paunch	contents of animal stomachs
pH	a measure of the acidity or alkalinity of the waste
Pickling	the process whereby fellmongered skins are agitated in a brine (salt) or acid mixture prior to tanning
Potable	water which can be used for drinking purposes
Primary Treatment	wastewater treatment which involves coarse and suspended solids and oil and grease reduction
Raw Water	water that has not undergone any treatment
Receiving Water	the waters into which effluent is discharged
Rendering	the cooking of animal wastes followed by drying to produce a proteinaceous meal and tallow
Saveall	A device to allow settling of solid and floating of fat
Secondary Treatment	wastewater treatment by biological processes to remove organic matter
Sewer/Sewerage system	the network of collection, conveyance, pumping, treatment and disposal facilities owned and/or operated by a sewerage authority
Sodium Adsorption Ratio	The SAR ratio is the ratio of sodium to calcium and magnesium. This ratio gives the sodium hazard of the water as excessive sodium in irrigation water can adversely affect soil structure
Stickwater	the liquid waste from either tallow washing or blood processing in rendering plants which is high in BOD, nutrients and salt
Suspended Solids	the insoluble solid matter suspended in wastewater that can be separated by filtration
Trade Waste	the liquid waste generated from any industry, business, trade or manufacturing process not including domestic wastewater
Ultraviolet Irradiation	the use of ultraviolet light for disinfection
Wastewater	raw (untreated) liquid flow from an abattoir
Wet weather storage	storage facility required to contain irrigation water during periods of heavy rain etc when irrigation is not required

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