final report

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Process integration study investigations into water use, salt discharge and energy reductions in the meat processing and rendering sector

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Executive summary

City West Water (CWW) and EPA Victoria (EPA) are working in partnership to improve trade waste management and to target critical parameters in trade waste discharges and reduce potable water consumption. Sustainability Victoria (SV) and EPA are also working in partnership to improve the efficiency of energy use. The abattoir and rendering sector accounts for a number of large water users, waste water generators and energy users. Significant work in waste reduction in this sector has been completed by Meat and Livestock Australia (MLA).

In May 2006, CWW(on behalf of EPA, SV & MLA) contracted JJC Engineering Pty Ltd (JJC) to conduct a Process Integration Study on the processes of seven Meat Processing Facilities and Rendering Facilities located within the boundary of the City West Water license area.

JJC conducted an assessment of water and waste flows at each of the sites, including the collection of various samples that were sent to NATA accredited laboratory EML (Chem) Pty Ltd. A review of the data was presented in Assessment Reports for each of the seven sites which focussed on identifying the strength and root causes of the waste streams. Energetics Pty Ltd conducted an assessment of energy use at five of the sites, and prepared individual reports of their findings. Following a workshop that identified ideas for Cleaner Production, JJC prepared a Projects Summary and Implementation Plan for each of the sites for review. As far as possible, personnel at the sites were engaged in the process along the way.

This document is a summary of the Process Integration Study.

The key findings from the study are:

- All sites are under pressure to minimise water use and reduce their environmental footprint. They are also involved in a very competitive industry and need to address:
    - Increasing demands for improved product quality
    - Increasing costs of production
    - Stringent regulatory controls
- Approximately $13,000,000 per annum is spent on water and energy related inputs across the seven sites.
- Benchmark figures for water consumption and sewer discharge flows are inconsistent and difficult to interpret, however all sites perform relatively well against industry benchmarks for water use, load to sewer, and energy use.
- About 5ML/day of water is used by the abattoirs and a further 1.5ML/day by the renderers. Potable water is used to clean and sterilise equipment, wash and convey edible product and inedible waste streams.
- The major contributors to wastewater load appear to be:
- Initial clean down, when water is applied to slaughterfloor and boning areas.
- Blood loss to drain after the initial collection
- Manure at the abattoirs.
- Stickwaters and condensates at the rendering plants
- Water usage and waste tracking is largely conducted at a site level, there does not appear to be any routine measurement or tracking of water and waste at a process or equipment level.
- Attention to housekeeping and engaging the workforce in improvement efforts will play a large role in reducing water and the load entering the sewer going forward.
- A number of issues are common to all abattoirs and all rendering sites. These issues may best be dealt with at an industry level with the costs and benefits spread across all sites.

There are significant opportunities to use Cleaner Production principles to reduce waste and minimise cost. A list of potential projects was developed during the workshop review process with each of the sites and CWW.

The projects selected covered the following key areas:

- Reduce load to sewer.
- Reduce and reuse water.
- Reduce energy use.

The projects are many and varied. Some require capital investment and others need changes to existing procedures. Many projects are simply ideas that require further investigation before a concrete solution can be identified. Reducing waste is an ongoing process, and the implementation plans are separated into immediate, medium and long term activities.
JJC recommends that the stakeholders (EPA,CWW, and each of the site's management) meet in 12 months time to review progress of the implementation plan.

Successful implementation of Cleaner Production initiatives will require site management to set objectives and devote resources to these issues on an ongoing basis. This will be a real cost, but the potential savings resulting from the project are significant. Furthermore, if operators are engaged, it will have "flow on" benefits in solving other processing issues (quality, efficiency as well as waste) at each site.

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1 Introduction

City West Water (CWW) and EPA Victoria (EPA) are working in partnership to improve trade waste management and to target critical parameters in trade waste discharges, such as total dissolved solids (TDS), heavy metals and potable water consumption. At current levels, these critical parameters present significant barriers to waste water and biosolids reuse, inhibiting the Victorian Government's ability to meet its target of recycling 20% of treated effluent from Eastern and Western Treatment Plants by 2010.

In addition, the generation of solid and liquid prescribed industrial waste represents a significant potential cost for companies, with the introduction of long-term containment signalling an increase in prescribed waste management prices from current levels.

In many cases the management of these waste streams is linked and seeking reductions in all streams maximises the gains to be made from such programs.

Sustainability Victoria (SV) and EPA are also working in partnership to improve the efficiency of energy use.

Applying cleaner production approaches to the management of these aspects of an industrial facility will deliver a multiple benefit, identifying cost effective options through efficiency gains, at the same time achieving energy reductions, salt and flow reductions in trade waste, and reducing the amount of prescribed waste sent to longterm containment.

The abattoir and rendering sector accounts for a number of large water users and waste water generators in the Western suburbs of Melbourne. They also generate high strength trade waste streams often high in BOD, TDS and phosphorous. This sector is also a high energy user. Significant work in waste reduction in this sector has been completed by Meat and Livestock Australia (MLA).

In May 2006, CWW contracted JJC Engineering Pty Ltd (JJC) to conduct a Process Integration Study on the processes of various Meat Processing Facilities and Rendering Facilities located within the boundary of the City West Water (CWW) license area. The seven industry partners are:

- ***Tasman Group Services*** (now Swift Australia (Southern) Pty Ltd) owns and operates this large red meat processing facility in Brooklyn.
- ***Baiada Poultry*** operates a poultry processing facility in Laverton North.
- ***Perfect Pork***. Australian Food Group operates a pork processing facility in Laverton North.
- ***Diamond Valley Pork*** operates a pork processing facility in Laverton North.
- ***BPL Melbourne.*** BPL Melbourne Pty Ltd operates a large inedible rendering plant in Laverton North; previously know as ***Pridham Tallows and Protein Meals.***
- ***Peerless Holdings*** operates a large edible rendering plant at Braybrook.
- ***Australian Tallow Producers*** operates an inedible rendering plant at its Brooklyn site.

The study was to be conducted with the aim of reducing energy and potable water use on site, identifying areas to reduce the total dissolved solids (TDS) and other pollutants of concern in trade waste discharged to sewer.
The study is jointly funded by CWW, Environmental Protection Authority Victoria (EPA) and Meat and Livestock Australia (MLA). City West Water is managing the project.

This report provides a summary of the information collected across all sites. It summarises the common issues faced by the sector as well as some of the generic Cleaner Production projects identified.

2 Scope of Assessment Activities

The first step in this studywas the preparation of the Project Program. It identified major components and/or phases of this project and expected individual completion dates and accountabilities for delivery. This project program was submitted in May 2006.

An overview of the project methodology is:

Phase 1. Project Program

Phase 2. Conducting Site Balance
- Literature Review
- Review of existing information for site
- Construction of mass balance

Phase 3. Resource Efficiency Identification
- Development of options
- Report on options

Phase 4. Stakeholder Workshop

Phase 5. Final Report
During the assessment phase of this project, JJC completed:
- Literature review.
- An assessment of water and waste flows at each of the sites, review of extensive records provided by the sites and CWW.
- A preliminary assessment of the data.
- A day or number of days on-site measuring flows and collecting wastewater samples for analysis.
- A draft report of the assessment phase of the project.

JJC subcontracted Energetics Pty Ltd to review energy use at five of the sites, Peerless Holdings and BPL Melbourne being the exceptions.

Following the assessment phases, JJC lead workshops involving key personnel from each site, as well as EPA and CWWrepresentatives where possible. The sessions presented the findings of the mass balance assessment.

The root causes of the major waste areas were discussed as well as the potential $ opportunities involved. Ideas were collected “from the floor” about how these wastes could be eliminated, reduced, reused or recycled through process or procedural optimisation and improvement. A list of opportunities was established at the workshop.

Following the workshops, JJC evaluated each of the identified opportunities by looking at:
- Benefits of the proposed change

- Cost savings on water, product or other streams
- Scope of change required
- Approximate cost to implement the change
- Barriers to change
- Priority ranking based on JJC's evaluation of each proposed options.

Areport summarising JJC's assessment of opportunities, benefits, costs and barriers, was provided for review with each of the sites.
AFinal Report that summarised the project's findings and the agreed implementation plan was prepared for each site.
Anumber of common issues were identified that could be addressed in collaboration by the industry as a whole.
This report provides a summary of the project as a whole and provides a brief description of the common issues.

3 Site Data

3.1 Site Overview

The seven sites are connected by the fact they are all involved in the meat processing and rendering industry.

- Three sites are abattoirs (2 pig and one poultry)
- Three sites are renderers
- One site, the largest, is both an abattoir and rendering facility

The total resources consumed annually by the seven sites are:

- 2,024ML of potable water
- 973,000 GJ of Natural Gas
- 59,000 MWHrs of Electricity, and
- 1,588 ML of waste water is sent to the sewer for treatment.

Performance against industry benchmarks for water and energy use indicates that all sites are close to the average and no one facility stands out as being far better or worse than typical industry usage.

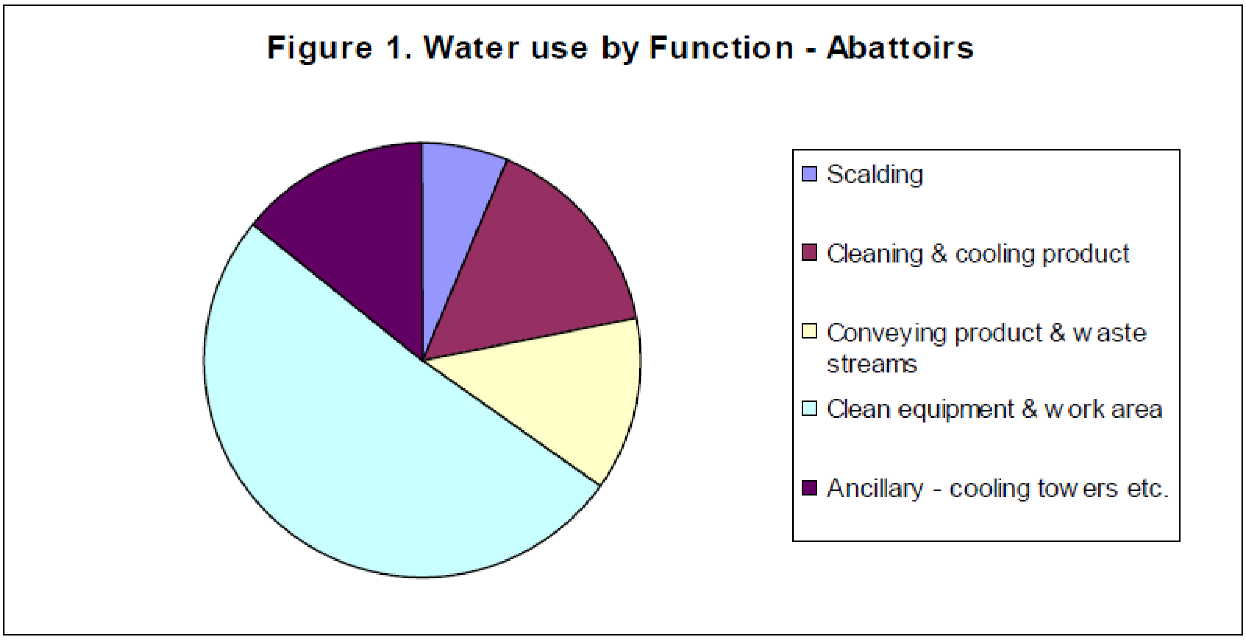
3.2 Water

Water is a critical resource for the meat processing industry. As shown in the pie chart below, water at potable standard is used primarily for hygiene purposes; to clean equipment and the work area, to clean and cool product and to convey product and waste streams.
Typical industry benchmarks for water use are:

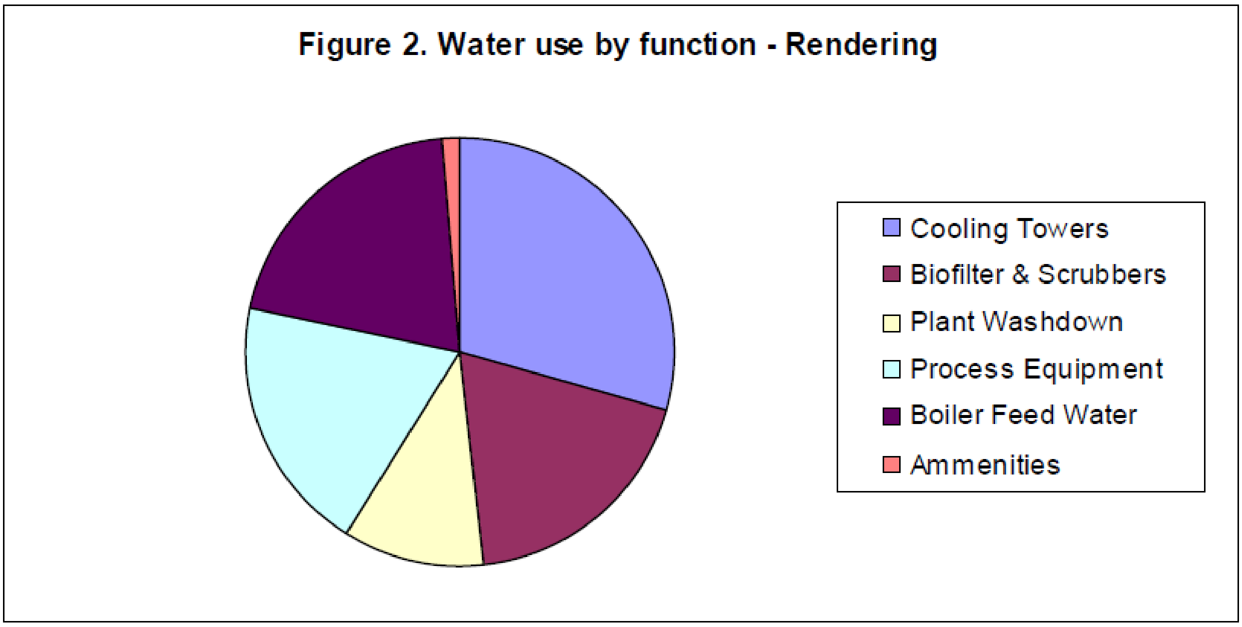
- 10.6L/kg of hot standard carcase for cattle and sheep
- 300L/pig (equivalent to about 4.5 L per kg of carcase), and
- 14.9L/chicken

The sites involved in this study are generally at industry standard for water use.

The breakdown of water use by function is shown in Figure 1. Nearly 50% of water is used in abattoirs to clean equipment and the work area. Significant quantities are also used to coll and clean product, convey product and waste streams and for ancillary purposes.



The rendering plants also consume a substantial amount of water to generate steam and cool vapour and liquid streams as shown in Figure 2 below. A substantial amount of water is also used in gas scrubbers and bio-filters to control odour at the rendering plants.



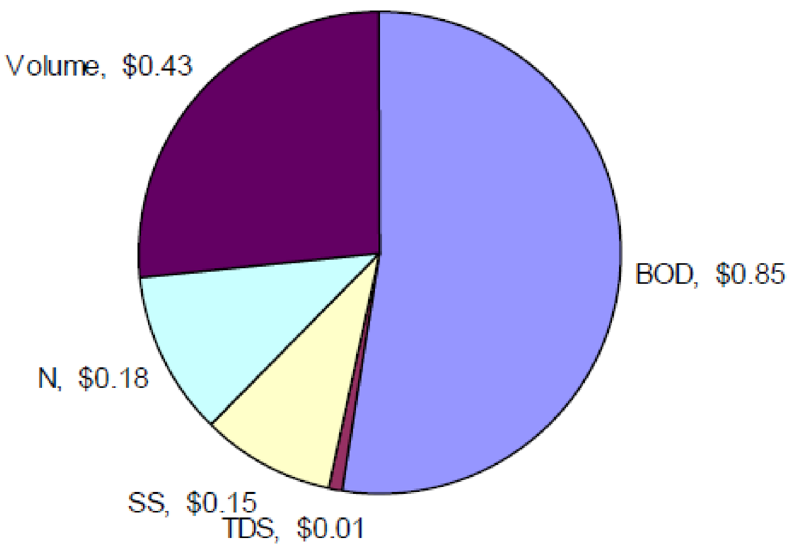
3.3 Wastewater

A total of 1,588ML of wastewater is discharged to the sewer from the seven sites involved in the study. The breakdown of the key components is:

- 3,134 Tonnes of BOD at an average concentration of 1,974mg/L
- 2,279 Tonnes of TDS at an average concentration of 1,435mg/L
- 999 Tonnes of SS at an average concentration of 627mg/L, and
- 343 Tonnes of Nitrogen at an average concentration of 216mg/L

Figure 3 shows the breakdown of trade waste charges by component. The average charge to sewer this waste stream would be $1.62/kL, with over 50% attributed to BOD loading. The charge rate for dissolved solids, of which salt is a portion, averages just 1c/kL.

Figure 3. Trade waste charge by component per kL



The major contributors to load in the waste water stream are:

- Blood, paunch contents and manure from the abattoirs, and
- Stick waters, condensates and raw material run off in the rendering plants.

The specific causes and opportunities to reduce load are discussed in each site report.

3.4 Prescribed Waste

The abattoirs produce a small amount of prescribed waste that is disposed under EPA's prescribed water regulations, A small portion of the manure, sump residues and some pig hair is disposed as prescribed waste.

3.5 Electrical Power

The use of electrical power at five of the sites was reviewed by Martin Cousins of Energetics Pty Ltd. Energetics findings are provided in a final report for each of the sites.

3.6 Natural Gas

The use of natural gas at five of the sites was reviewed by Martin Cousins of Energetics Pty Ltd. Energetics findings are provided in a final report for each of the sites.

4 Key Findings

- All sites are under pressure to minimise water use and reduce their environmental footprint. They are also involved in a very competitive industry and need to address:
    - Increasing demands for improved product quality
    - Increasing costs of production
    - Stringent regulatory controls
- Approximately $13,000,000 per annum is spent on water and energy related inputs across the seven sites.
- Benchmark figures for water consumption and sewer discharge flows are inconsistent and difficult to interpret, however all sites perform relatively well against industry benchmarks for water use, load to sewer, and energy use.
- About 5ML/day of water is used by the abattoirs and a further 1.5ML/day by the renderers. Potable water is used to clean and sterilise equipment, wash and convey product as well as waste streams.
- The major contributors to wastewater load appear to be:
- Initial clean down, when water is applied to slaughter floor and boning areas.
- Blood loss to drain after the initial collection
- Manure in the abattoirs.
- Stick waters and condensates in the rendering plants.
- Water usage and waste tracking is largely conducted at a site level, there does not appear to be any routine measurement or tracking of water and waste at a process or equipment level.
- Attention to housekeeping and engaging the workforce in improvement efforts will play a large role in reducing water and the load entering the sewer going forward.
- A number of issues are common to all abattoirs and all rendering sites. Some of these issues are discussed below under “Opportunities for Cleaner Production”. These issues may best be dealt with at an industry level with the costs and benefits spread across all sites.

5 Opportunities for Cleaner Production

The objectives for Cleaner Production are fairly straight forward:

- Use less water
- Reduce load loss to wastewater
- Use less gas and electricity.

Each of the seven sites was involved in a similar process to look at opportunities to reduce or eliminate waste by doing things differently. The extensive data collected during the first phase of the project was used to assist this process. A large number of opportunities were identified in workshops with site personnel and following the workshops, JJC evaluated each of the identified opportunities by looking at:

- Benefits of the proposed change
- Cost savings on water, product or other streams
- Scope of change required
- Approximate cost to implement the change
- Barriers to change
- Priority ranking based on JJC's evaluation of each proposed options.

The resulting project lists were reviewed and formulated into implementation plans at a site level. There were a number of issues identified that were common to several sites and may be best tackled co-operatively by the industry. Those issues are discussed briefly below:

Condensate Reuse at Renderers

The rendering process involves evaporation of water from rendered material either by using steam jacketed evaporators or hot air driers. The water vapour driven from the material is condensed by cooling water in heat exchangers to produce a process condensate.

The process condensate contains very low levels of salt, but does contain volatile organics and ammonia that are vaporised or steam distilled during the evaporation process. Typically, the process condensate might contain 500 mg/L ammonia and a Chemical Oxygen Demand (COD) of 2000 mg/L. The condensate is odorous.

Two opportunities for reuse are apparent:

- If the odour can be removed from the condensate, then the condensate could be used for wash-down water within the rendering facility. An additional advantage is obtained by reusing the heat available in hot condensate, reducing steam use for heating of water for wash-down.
- If most of the organics and ammonia could be removed from the condensate, then the water could provide a low salt water stream to be used for boiler and cooling tower feedwater.

The four rendering plants included in this study produce an estimated 160 ML p.a of condensate that might be reused.

In concept terms the reuse of condensate offers the potential for renderers to be a “zero” water user, with the condensate that is extracted from raw material eliminating the use of supplied potable water at the site.

The next step in developing this initiative is identifying and then proving processes to treat the condensate for reuse.

Manure Handling and disposal

At the abattoirs studied, the majority of manure is washed to the sewer. An estimated 1300 tpa of manure is washed to sewer using 60 ML p.a of potable water. The manure constitutes an estimated annual load of:

- COD 205 tpa
- Total Dissolved Solids 42 tpa
- Total biogas generation.
- A major difficulty Nitrogen 21 tpa.

Two beneficial outlets for manure were identified:

- To agriculture, perhaps via composting.

To is the cost-effective recovery of manure. If water is used to wash manure to a sieve that recovers solids, then the salts dissolve in the water, and are discharged to trade waste. Systems that recover the majority of manure as a slurry or solid are required.

In washing the manure to sewer, a proportion (perhaps the majority) of the manure is converted to biogas in the anaerobic lagoons at Melbourne Water's Western Treatment Plant.

Biogas generation recovers energy value from the waste stream, but would typically result in continued discharge of the salt to trade waste, unless the salt can be recovered as a fertiliser liquid or solid by-product from the biogas process.

The next steps in developing this initiative are:

- Develop techniques for recovery of manure at each abattoir.
- Encourage outlets other than the sewer, for manure

DAF Sludge Ex Rendering

Rendering processes, particularly continuous wet rendering which was used at 3 of the 4 sites in the study, produce a water-borne organic-rich waste stream. Renderers typically treat the stream with Dissolved Air Flotation (DAF) processes, to recover the organics as a sludge. They may return this sludge to the rendering process and recover meal and tallow from it.

However, attention to market specifications for tallow and meal has increased, making it difficult to blend back DAF sludge with other raw materials. So, there is a tendency is to release the DAF sludge to sewer, or dispose a prescribed waste to landfill, at a substantial cost.

If this material cannot be incorporated into product, diversion to biogas production is a potential alternative outlet. Release to the sewer is problematic because the sludge contains a high fat content that may clog sewers.

Trade waste charging regimes provide strong disincentive to discharge this material.

The next step in developing this initiative is:

- Encourage the establishment of a biogas facility to treat DAF sludge.

Segregation of Abattoir Strong Streams to Evaporation

Abattoir wastewater is characterised small volumes of strong wastes, diluted into large volumes of relatively dilute wastewater from sterilising and washing operations.

The strong waste streams generated at abattoirs include:

- Leachate from the edible and inedible offal screws.
- Initial wash down of sticking and evisceration surfaces..
- Scour wastewater in pork processing.

In concept, segregating these strong wastes from the general wastewater stream and diverting them to evaporation achieves reduction in salt loads to sewer. If evaporation occurs within rendering, then the segregated salt and organics are recovered into valuable meal and tallow. Evaporation might also be achieved through diversion of the wastes to agricultural, composting and biogas/fertiliser processes.
At the four abattoirs involved in this study, a total volume of 22 ML p.a of strong streams was identified, containing 1100 tonne p.a of solids.
None of the renderers included in this study currently accept this style of waste.
The next steps in developing this initiative are:

- Develop techniques for recovery of strong streams at each abattoir.
- Encourage outlets other than the sewer, for these strong streams.

Utilisation of Waste Heat at the Renderers.

Rendering uses large amounts of natural gas to evaporate water from raw material . The waste heat from this process is produced as hot gas and water. At the four rendering sites studied, the hot water produced was an estimated 160 ML p.a, containing 70,000 GJ of energy, worth $350,000 p.a as natural gas.
Even where an abattoir is coupled with a rendering plant, the rendering plant appears to produce an excess of waste heat.

The opportunities for use of this waste heat appear to be:
- Provision of the hot water to a adjacent business capable of using the heat.
- Use of heat pump or absorption refrigeration technology to recover the heat at a useful temperature.

Potential reuse in applications as wide as steam generation, and refrigeration are reported in the literature.

Direct Steam Return

All the renderers in this study use a traditional steam condensate recovery system, in which, condensate is relieved to atmospheric pressure, at steam traps or flash vessels, prior to pumping of the returned condensate into the boiler. Relief to atmospheric pressure results in loss of about 5% of the heat energy contained in the condensate.

At rendering sites included in this study, the heat loss is an estimated 37,000 GJ p.a, worth $80,000 p.a. Two renderers have been offered technology for pressure return of condensate direct to the boiler, minimising loss of heat. However, the renderers report that complications in regulation of the processes by government authorities.

The next step is to determine the regulatory impediments to application of the technology.

6 Strategies & Actions

In consultation with each of the sites, the listing of potential projects was reviewed to prioritize the options in order to develop an implementation plan for the site.

The Implementation Plans were structured around three strategic elements:

- Reduce load to sewer.
- Reduce and Reuse water.
- Reduce energy usage

The list of opportunities was reviewed and sorted by priority and implementation timeframe, into an Implementation Plan. A summary of the high ranking projects was also presented in the final reports.

JJC recommends that the stakeholders review the progress towards the implementation plan at each site in twelve months time.