Dairy Processing Plants

Purpose

Dairy processing plants are long standing and valued contributors to the well-being of the Western Australian community and State economy. Like other WA industries they need to operate in harmony with the environment to ensure their sustainability and ongoing community support.

The operation of dairy processing plants should:

- protect the environmental values of surface water, groundwater and ecosystems from an increase in organic matter, nutrients, salts, chemical and biological contaminants, pH and temperature; and
- prevent any unacceptable changes in soils to which effluent is added including structural decline, increased salinisation, acidification, chemical and biological contamination, waterlogging, soil loss via erosion and decrease in permeability.

This Water Quality Protection Note is designed to compliment the National Water Quality Management Strategy document Number 16b titled *Wastewater Management Guidelines for Dairy Processing Plants*.

The Department of Environment is responsible for managing and protecting the State’s water resources. It is also the lead agency for water conservation and reuse. This note offers:

- the Department’s current considered views on environmental management for dairy processing plants;
- guidance on acceptable practices used to protect the quality of Western Australian water resources; and
- a basis for development of a multi-agency code or guidelines designed to balance the views of industry, government and the community, while sustaining a healthy environment.

This note is intended as a generic guide on issues of environmental concern to areas where water resources are susceptible to contamination, and to offer potential solutions based on professional judgement and precedent. Its use does not override any statutory obligation or Government policy requirement. Anyone may propose alternative practicable environmental solutions suited to local conditions. The recommendations should not be used by regulators in place of a site specific assessment of any project’s environmental risks. Any conditions set should consider the values of the surrounding environment, the safeguards in place, and take a precautionary approach. This note shall not be used as our policy position on a specific matter, unless confirmed in writing by this agency. The note may also be varied at our discretion, as new data becomes available.

Scope

This note applies to WA dairy processing operations including milk and dairy factories, their wastewater treatment facilities and associated irrigated land. It is intended as a guide for use by the dairy processing industry, consultants, regulators, planning authorities and the broader community.

The upstream process of primary milk production on dairy farms is not covered in this note, since this activity is more related to the agricultural sector and covered by other guidelines. Similarly, downstream processes of distribution and retail of dairy products are not covered.
This note particularly applies to developments within areas containing sensitive environments. Sensitive environments may include the following:

- Drinking water source catchments. For further information please refer to the Water Quality Protection Notes titled *Overview on Protecting Public Drinking Water Source Areas (PDWSA)*, *Private Water Supplies* and *Land Use Compatibility in PDWSA*.

- The Swan River Trust Management Area. For further information please telephone the Swan River Trust on (08) 9278 0400 or visit the web site at <www.environment.wa.gov.au>.

- Waterways Management Areas (including the Albany Waterways, Avon River, Leschenault Inlet, Peel–Harvey, and Wilson Inlet management areas).

- Locations near any wetland. For further information please refer to the *Position Statement on Wetlands*.

- Locations near a waterway, eg. near the banks of streams, rivers and estuaries. For further information please refer to *Foreshore Policy No. 1 Identifying the Foreshore Area* and *Water Note 23 Determining the Foreshore Reserve*.

- EPA Environmental Protection Policy areas. Further information is available via <www.environment.wa.gov.au>.

- Areas supporting native vegetation may be regarded as sensitive. Some activities that involve clearing may be subject to amendments to clearing regulations under the *Environmental Protection Act 1986* (information is available via <www.environment.wa.gov.au>) and *EPA Position Statements 2 and 3 and Guidance Statements 51 and 56* (available via <www.epa.wa.gov.au>). The *Wildlife Conservation Act 1950* may be relevant where native vegetation includes Rare Flora and Threatened Fauna species. For Bush Forever sites, refer to the WA Planning Commission via <www.wapc.wa.gov.au/publications/bushforever> or by telephoning (08) 9264 7777.

- Other constraints may apply to land subject to flooding or where the watertable is within two metres of the ground surface.

For further information about the references listed above, see Appendix A – References and Further Reading. You may telephone the nearest regional office of the Department of Environment for further information about the location and protection of sensitive environments in WA.

**Introduction**

The dairy industry, including dairy farms and dairy processing plants, is Australia’s fourth largest rural industry in terms of gross value of production. Western Australia is responsible for about 4 percent of Australia’s dairy production.

The dairy industry is divided into two main production areas:

- the primary production of milk on farms – the keeping of cows (and other animals such as goats, sheep etc.) for the production of milk for human consumption; and
- the processing of milk – with the objective of extending its saleable life. This objective is typically achieved by:
  a. heat treatment to ensure that milk is safe for human consumption and has an extended keeping quality; and
  b. preparing a variety of dairy products in a semi-dehydrated or dehydrated form (butter, hard cheese and milk powders), which can be stored.

Major dairy companies in WA have processing plants in the Perth metropolitan area, Boyanup, Brunswick and Capel. Small processing plants are located in the Perth metropolitan and outer metropolitan area and near Harvey and Margaret River.
About 40 per cent of the State's milk production is sold as fresh milk, the remainder being used for products such as flavoured milk, UHT milk, cream, cheese, butter, milk powders, ice cream, yoghurt and dairy desserts. The volume of milk produced in WA has remained at an approximate level of 400 million litres of raw milk for the last three years despite decreasing numbers of dairy farmers. This static growth is largely due to restructuring that is taking place as a result of deregulation.

Potential environmental issues associated with dairy processing activities include the significant consumption of water for processing and cleaning, the discharge of wastewater with high organic loads, unpleasant odours and the consumption of energy. Water has many uses in dairy processing including cooling, washing, heating and cleanup. The majority of water is used for cleaning process equipment and work areas to maintain hygiene standards. Some dairy plants are located in communities without abundant potable water sources and can have a major draw on the local fresh water resources. In addition wastewater with a high organic strength, if discharged to municipal sewage treatment systems, can place a significant burden on small scale wastewater treatment plants.

Wastewater characteristics

Milk is a complex biological fluid consisting of milk fat, protein, lactose and lactic acid, as well as sodium, potassium, calcium and chloride. Dairy products contain all or some of the milk constituents and, depending on the nature and type of product, may also contain sugar, salts, flavours, emulsifiers and stabilisers. Neither fresh milk or dairy product manufacturing results in the direct release of toxic products.

Dairy processing wastewater characteristics vary markedly depending on milk load dilution with wash water, pre-treatment, cleaning compounds and age of plant. Appendix B provides an overview on potential sources of waterborne waste. Dairy processing wastewater contains predominantly milk and milk products, such as whey, which have been lost from the process, as well as detergents, sanitisers, acidic and caustic cleaning agents, nutrients, dissolved solids including sodium chloride and small amounts of lubricants. Wastewater derives from tanker wash down, equipment and pipeline cleaning, spillage and cleaning work area floors.

Hazardous or contaminated wastes may be derived from oily sludge from gearboxes of processing machinery, laboratory waste, cooling agents, batteries, paint cans, cleaning agents, lubricants and the solids from equipment and floors.

Biochemical oxygen demand is a measure of how much dissolved oxygen is being consumed as microbes break down organic matter. Typical process wastewater has a BOD of about 2,000mg/L and a dissolved solids concentration of 1,800mg/L. If the BOD level in a plant’s wastewater is known this information can be used to estimate how much product (and lost income) is going down the drain.

Recommendations

Site selection

1. Siting has a significant impact on the intensity and cost of wastewater treatment and the management effort required to protect water quality. Where possible, the site selected should be located away from sensitive environments (see the Scope for a definition of sensitive environments). New dairy processing plants should not be situated adjacent to a waterway or wetland, within a floodway or in a riparian vegetation zone.

2. In order to provide a basic level of protection from impacts such as contaminated water runoff, odour and noise a dairy processing plant should be located outside a minimum buffer distance to designated residential areas, water resources, and other sensitive environments. In respect to water resources, separation buffers are generally determined on the basis of agreed waterway values, vulnerability and biophysical criteria (see Reference 2.3g). The buffers should be covered with natural vegetation, sustainable with minimal intervention and protected from impact by adjoining land use activities. For information on appropriate buffer distance contact your local Department of Environment office.
3. The following factors should be considered during the site selection and design process:
   a. the proximity and availability of services and amenities including water supply and waste disposal;
   b. appropriate siting of any wastewater treatment and disposal areas;
   c. neighbouring land uses;
   d. the suitability of the associated land for irrigation purposes;
   e. the proximity to sensitive surface and ground water resources; and
   f. the land area required for establishing the enterprise and the potential for future expansion.

Public Drinking Water Source Areas (PDWSAs)

PDWSAs include Underground Water Pollution Control Areas, Water Reserves and Catchment Areas declared under the Metropolitan Water Supply, Sewerage and Drainage Act 1909 or the Country Areas Water Supply Act 1947. They provide for public (scheme) water supplies within defined catchments. By-laws under these Acts provide the Department of Environment with regulatory powers to protect water resources used for public drinking water supplies. For information on the location of these areas contact the local Department of Environment office.

Policy used to protect PDWSAs define three priority classifications of land areas based on land tenure and intensity of use. Management strategies differ for each priority classification. For detailed information, refer to the Water Quality Protection Note Land Use Compatibility in Public Drinking Water Source Areas.

4. In Priority 1 (P1) PDWSAs: dairy processing plants are incompatible. Incompatible means the activity is likely to conflict with this Department’s policy designed to protect drinking water quality. In P1 areas the objectives are no degradation of water quality and risk avoidance.

5. In Priority 2 (P2) PDWSAs: dairy processing plants are incompatible. P2 areas are managed based on the principle of risk minimisation. The management objective is to ensure that there is minimal risk of contamination of the water source beyond its present ambient (seasonal) quality.

6. In Priority 3 (P3) PDWSAs: dairy processing plants are compatible with conditions, but should where practicable be connected to deep sewerage unless exemptions apply under the Government Sewerage Policy. Management practices should be conducted without significant risk of increasing contamination to local water resources above the guideline values defined in the current Australian Drinking Water Guidelines. P3 areas are designed to manage the risk of contamination to water sources.

Planning and approvals

Some of the following plans and approvals may be necessary depending on the location and proposed operation of the dairy processing plant.

7. A whole business plan should be prepared prior to the establishment and management of dairy processing operations. The plan should include a map of the dairy processing operations and a strategic plan for the business enterprise including establishment, operation, best practice management, markets, finance, water and environmental management, ongoing risks and opportunities.

Local Government Authority

8. The first point of contact for planning the development of a dairy processing facility and for land use planning related queries should be the local government authority (LGA). The LGA is responsible for land zoning and development approval through the Town Planning and Development Act 1928.

9. Any discharge to septic tanks should be approved through the local government authority in accordance with the Health Act 1911.

10. Permission for the discharge of treated wastewater to stormwater drains must be obtained from the operator of the drain (normally your local government authority or Water Corporation for main drains).
Water Corporation

11. An Industrial Waste Discharge Permit should be obtained by all waste generators wishing to discharge wastewaters, process liquids, groundwater or stormwater into sewer under the Water Corporation Act 1995, Metropolitan Water Supply, Sewerage and Drainage Act 1909 and the Country Towns Sewerage Act 1948. All wastewaters discharged to sewer must comply with the Water Corporation’s Acceptance Criteria for Industrial Wastes.

Swan River Trust

12. If a development is located within a Swan River Trust Area approval should be sought from the Trust in accordance with the Swan River Trust Act 1988. For information on locations of these areas contact the Department of Environment.

Department of Environment

13. Under the Environmental Protection Regulations 1987 (as amended), milk processors (that produce more than 100 tonnes of product per year and discharge to land or waters) require a Works Approval prior to their construction and a Licence prior to their operation. These Regulations apply to premises on which (a) milk is separated or evaporated (other than a farm); or (b) evaporated or condensed milk, butter, ice cream, cheese or any other dairy product is manufactured, and from which liquid waste is or is to be discharged onto land or into waters.

The licensee should take all reasonable and practicable measure to prevent or minimise the discharge of waste and the emission of noise, odours or electromagnetic radiation from the premises.

Licences and Works Approvals are issued with legally binding conditions that apply to specific premises and are intended to prevent or minimise the potential for pollution. For further information call the local Department of Environment office or refer to A Guide to the Licensing System – Licenses and Registration available from the website <www.environment.wa.gov.au> or by telephoning the Department of Environment on (08) 9222 7000.

14. The transport of wastes that may cause environmental harm or health risks is regulated by the Department of Environment. It does so through the application of the Environmental Protection (Controlled Waste) Regulations 2001. The Regulations require all carriers transporting controlled waste on public roads to be licensed, as well as drivers and vehicles used to transport bulk controlled waste. Controlled wastes include all liquid wastes and solids that may not be disposed of to a Class I, II or III landfill facility.

15. The discharge of certain prohibited materials may be regulated through the Environmental Protection (Unauthorised Discharge) Regulations 2004. For further information contact your local Department of Environment office.

16. Non-sewerable liquid wastes are regulated using the Environmental Protection (Liquid Waste) Regulations 1997. Any discharge to the environment should be treated to ensure that it meets water quality guidelines for the protection of aquatic ecosystems. Permission for the discharge of treated wastewater to land or soakage must be obtained from the Department of Environment.

17. If the processing plant requires surface or groundwater to be drawn from the environment, a water allocation licence may be required under the Rights in Water and Irrigation Act 1914 (if situated in a declared water allocation management area or drawing from a confined aquifer). To apply for a water allocation licence please contact the nearest regional office of the Department of Environment or telephone (08) 92780300. Further information is available via <www.environment.wa.gov.au>.

18. If a development is located within a Waterways Management Area, approval should be sought from the Department of Environment under the Waterways Conservation Act 1976.
19. A proposed development within 200 metres of any wetland should be referred to the local Department of Environment office for assessment. Wetland types include lakes, damplands, sumplands and palusplains. On the Swan Coastal Plain a proposed dairy processing development within 200 metres of any Conservation Category, Resource Enhancement Category or wetlands gazetted under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 should be referred to the local Department of Environment office for assessment. For more information refer to the Department of Environment’s Position Statement: Wetlands 2001 and Water Note 4 Wetland Buffers 2000.

20. The National Pollutant Inventory (NPI) is an Internet database designed to provide the community, industry and government with information on the types and amounts of certain substances being emitted into the environment. A total of 90 substances are reported to the NPI. There are legal obligations for companies to report estimates of emissions of these substances from their facilities, as set out in the Environmental Protection (NEPM-NPI) Regulations 1998. The onus is on each facility to report emissions of each NPI substance which exceeds NPI thresholds. For further information on industry reporting to the NPI, visit the website <www.npi.gov.au> or phone the NPI Unit at the Department of Environment on (08) 9278 0635.

21. Noise emissions from operations on site are required to comply with the Environmental Protection (Noise) Regulations 1997.

Other

22. The construction of facilities should be consistent with Food Standards Australia New Zealand (FSANZ) and Australia New Zealand Food Authority (ANZFA) Standards and Codes of Practice.

Establishment and operation

Cleaner Production

Cleaner Production aims to improve the environmental performance of operations by focusing on the causes of environmental problems rather than the symptoms. It is most commonly applied to production processes through the conservation of resources, the elimination of toxic raw materials and the reduction of wastes and emissions. Cleaner Production can benefit an operation through reduced costs in operating, waste treatment and disposal as well as a reduced liability risk.

23. Cleaner Production strategies should be investigated for all aspects of the operation and may include:
   a. better housekeeping;
   b. life cycle planning (design phase through to consumption and disposal phase);
   c. state of the art in-plant production processes including partial cleaning in place (CIP) recovery;
   d. incorporating modern technologies and processes for water conservation, waste minimisation, wastewater treatment and recycling/reuse;
   e. condensate recovery and advancement towards a ‘closed’ water cycle; and
   f. selection of appropriate recovery processes which provide potential for adding value through by-products.

24. Cleaner Production amongst the dairy farming industry is gaining greater acceptance. Through programs such as DairyCatch, industry is becoming more proactive in seeking best environmental management practice. Dairy processors can play an important role in supporting these programs and encouraging dairy farmers who follow best practice. For further information on DairyCatch contact the GeoCatch Office in Busselton on (08) 9754 4331.

25. Curtin University’s Centre of Excellence in Cleaner Production has developed information notes for the food processing industry and they also offer training in applying the cleaner production approach to your business operations. Further information is available by contacting the Centre on (08) 9266 4520 or via the Centre’s web site <http://cleanerproduction.curtin.edu.au/resources.htm>. Additional information on Cleaner Production is available from the Department of the Environment and Heritage website <www.deh.gov.au> and the UNEP website <www.geosp.uq.edu.au/emc/cp/Res/facts/FACT2.HTM>.
Environmental management

26. Steps to improving environmental management in a dairy processing operation should include:
   a. ensuring management is committed to water conservation and waste load reduction;
   b. creating a positive culture amongst employees and solicit their ideas towards water conservation and waste load reduction;
   c. training operators in total quality management procedures and risk management techniques;
   d. considering the appointment of an environmental supervisor who is responsible for setting and implementing specific water conservation and waste load reduction goals for the plant;
   e. allocating an appropriate share of management effort and expenditure;
   f. good communication within the organisation to increase overall efficiency including risk identification; and
   g. establishing control over the product and processes through a program of Quality Assurance.

27. Sustainable management of dairy processing wastewater should be achieved by the development of an Environmental Management Plan. The basis of this Plan is to report on the plant’s activities and may include:
   a. annual reports on environmental performance; and
   b. exception reporting to alert of unusual variations in plant performance and significant deviation from licence requirements.

28. The Environmental Management Plan should be integrated with an Environmental Management System (EMS) which incorporates a process of review and continuous improvement. Through this process all potential opportunities for water conservation, pollutant reduction and recycling should be investigated. The EMS provides the management, administration and monitoring framework for an operation’s environmental aspects. It should include risk management and auditing. The EMS may be certified (ISO 14001), further information is available from the <www.iso.ch/iso/en/ISOOnline.frontpage> website.

Water conservation

29. At modern dairy processing plants, a water consumption rate of 1.3 to 2.5 litres water per kilogram of milk intake is typical, however 0.8 to 1.0 litre water per kilogram is possible (Reference 3f). Operators should begin to implement water use efficiency procedures in all aspects of their business. For general information on water saving options refer to the Water Corporation’s Waterwise Program website at <www.watercorporation.com.au/savingwater/index.cfm?rootparent=beingwaterwise>.

30. The processing plant design should ensure that stormwater runoff and contamination is minimised. Any contaminated stormwater should discharge to an adequately designed wastewater treatment system. Clean stormwater should be diverted away from the processing plant and its wastewater treatment system. For further information on stormwater management in Western Australia refer to the Stormwater Management Manual for Western Australia available at <www.environment.wa.gov.au>.

31. Other options for conserving water may include:
   a. regularly inspecting facilities, in particular pumps and waste storage ponds, and fixing leaks promptly;
   b. using continuous rather than batch processes to reduce the frequency of cleaning;
   c. using automated cleaning-in-place (CIP) systems or installing fixtures that control the flow of water for manual cleaning processes (eg. automatic shut-off nozzles on water hoses);
   d. manually sweeping up spills rather than washing with water hoses;
   e. using high pressure, low volume water cleaning systems;
   f. reusing relatively clean wastewater (such as that from final rinses) for other cleaning steps or in non-critical applications;
   g. installing water meters at strategic locations within the plant, reading them regularly and logging the results.
**Chemical reduction**

32. Process equipment, pipes and tanks should be kept clean and free of unwanted micro-organisms to maintain hygiene standards. This is generally achieved with a periodic chemical flushing process called, Cleaning in Place (CIP), and involves the use of both alkaline solutions and acidic cleanser. The acidic cleanser normally used is a mixture of nitric and phosphoric acids. These chemicals ultimately discharge to the wastewater treatment facility and increase the load on the system. Chemical use should be minimised and other less environmentally hazardous chemicals substituted for sodium based reagents and nitric and phosphoric acids where possible (eg. potassium in place of sodium compounds).

33. Cleaning chemicals should be recovered and reused on site including alkalis, acids, surfactants, sequestrants, peptizing agents, enzymes and oxidizers. The use of modern membrane systems (eg. reverse osmosis) should be investigated as they can achieve up to 80 percent recovery of acids and alkalis used for cleaning and dissolved solids.

**Waste minimisation**

Milk loss to the wastewater stream can amount to 2 to 3 percent of the incoming milk, but can be as low as 0.5 percent in efficient plants (Reference 3f). Stopping pollution at its source is less expensive and more practical than ‘end-of-pipe’ waste treatment.

Small solid particles enter the wastewater drainage system during normal production, daily wash down and the CIP process. These particles represent a loss of product and add an unnecessary load to the wastewater treatment facility. Recovered wastewater treatment sludge and defective product packaging are other potential sources of solid waste.

34. Systems in which equipment malfunction or accidental spillage of wastewater or products could occur should have effective alarms or interlock systems and the areas should be located over concrete pads or hard stand with adequate perimeter bunding draining to wastewater containment areas.

35. Fat, milk solids and minerals should be recovered from processing and recycled or reused for animal feed or fertiliser either at the dairy plant or off-site. By-product such as whey, buttermilk and skim milk should be collected for reprocessing into higher value products (eg. skim milk powder, buttermilk powder, whey powder, whey protein concentrate or casein) or recovery processes used to remove valuable constituents (eg. soluble proteins and lactose). Production and recovery processes need to be selected so that chemical contamination does not occur.

36. Captured solids and wastewater treatment pond sludges should be digested or dewatered using drying beds, a filterpress or chemical coagulation. The solids can be composted so that the material is able to be used on land in a dry stable state as a form of fertiliser. The sludge quality should be analysed and spread onto land in quantities consistent with plant needs and water quality objectives. Alternately it may be possible to sell the material to reprocessing companies. For further information on composting contact the Department of Agriculture on 1300136016 and for information on reprocessing companies contact the Department of Environment Waste Management Branch on (08) 9278 0300.

37. Fuel and chemical storage should be consistent with the Water Quality Protection Note *Tanks – Above Ground Chemical Storage.*
38. Options for minimising waste include:
   a. draining vats, vessels and pipes completely of product before cleaning;
   b. using starch plugs or cleaning pigs to recover product from pipes before cleaning;
   c. separating waste stream components such as solids from liquids, high from low salinity wastewater, and wastewater from ion exchange processes to improve wastewater quality;
   d. reducing residues, where viscous and fatty products stick to equipment, by minimising equipment surface areas, maintaining equipment and correct preparation of ingredients before filling;
   e. using level controls and automatic shut-off systems to avoid spills from vessels and tankers;
   f. cleaning up spills before washing;
   g. installing suitably sized and well maintained screens or properly trapped and covered floor drains with removable covers at points where large solid losses can occur and enter the wastewater;
   h. installing grease traps for processes in which fat and protein losses are high; and
   i. installing settling tanks to capture solids in the process rinse water.

**Effluent treatment**

A number of dairy processing plants in WA are connected to sewer, however the majority of country based plants treat and dispose of their effluent on-site. Some form of wastewater treatment is required for almost all plants to reduce the organic loading to a level that causes minimal environmental impact and does not constitute a health risk. The selection of a treatment process will depend mainly on the site, the components of the wastewater and concentrations, available practicable and affordable technologies, the solid waste and sludge production, the desired final quality of the wastewater and discharge point, and cost.


40. The treatment system should capture discharge from all tanker wash and plant wash-down and permit safe, effective and sustainable use of liquids and separated solids. The treatment system should take account of the quantity, quality and intermittent generation of wastewater.

41. The treatment system should be designed to either reduce, or deal with organic matter (ie. BOD), suspended solids, nutrients, pH and temperature fluctuations, salt and surfactants. Balance tanks can be employed to assist in evening out variations in pH, organic strength and temperature.

42. Treatment systems may incorporate physical, biological, or chemical treatment processes (see Appendix C for information). Organic load can be reduced by physical methods such as microfiltration, reverse osmosis, centrifugation and flotation techniques; biological treatment such as activated sludge systems, trickling filters and anaerobic digesters; and/or chemical treatment to aid in clarification, coagulation, and settling of biological solids.

43. Conventionally treatment in ponds takes place via a treatment train involving anaerobic, facultative/aerobic, and/or polishing ponds. Ponds should be designed to waste stabilisation pond criteria, catering for maximum hydraulic and waste load with capacity for effective water containment during the statistical wettest year in ten. Low permeability clay, concrete and/or synthetic pond liners should be used for the construction of wastewater treatment ponds in porous soils. Ponds are most easily installed where the land slope is less than one in ten, the watertable is below one metre from the pond base and the soils are deep and sufficiently impermeable (less than 10mm/day permeability) to retain the wastewater. Refer to the Water Quality Protection Notes on *Ponds for Stabilising Organic Waste and Soil Liners to Contain Low Hazard Waste* for information.

44. Ponds should not be constructed where overflows can enter surface waters or natural wetlands. In addition, treatment systems should have an effective scum trapping system to prevent release of floating matter.
45. Periods when land application may not be practicable need to be considered for wastewater storage. Allowance should be made for ponds to be taken out of service, solar dried and desludged periodically. Ponds should be desludged once the sludge takes up one third of the volume of the pond.

46. Planning for any increase in dairy processing production needs to consider the capacity of the wastewater treatment system. Treatment capacity can be augmented in several ways including:
   a. load reduction due to improved housekeeping and/or wastewater stream segregation;
   b. chemical or microbiological supplements (eg. settling of solids by pH correction);
   c. physical pretreatment processes;
   d. artificial aeration of ponds (eg. use of floating aerators);
   e. anaerobic pretreatment processes with appropriate controls on gases generated; and
   f. expansion of the storage pond capacity.

**Disposal of treated effluent and solids**

47. If effluent is unsuited to on-site disposal, tanker or pump stabilised wastes to an area where they can be disposed of safely, minimising risk to the environment. In areas where deep sewerage is available this option should be explored through discussions with the Water Corporation. Disposal methods should meet local government health and planning criteria. Contact your local government office or nearest regional office of the Department of Environment for further information.

48. If effluent requires on-site disposal but is not suitable for irrigation to land, the use of solar evaporation in effective containment ponds may be considered. For instance it may be appropriate to treat highly saline wastewater through evaporation ponds so that salts and other recyclable products can be recovered. Ponds should be consistent with the Water Quality Protection Note *Ponds for Stabilising Organic Waste*.

49. Captured solids and pond sludge should be held within imperviously lined storage areas that are bunded and have adequate drainage back to the wastewater treatment system.

50. Solid wastes should be stabilised, dewatered and then digested, composted and/or stored appropriately for reuse or recycling. Captured solids and sludges may have value for animal feed or for use in a controlled manner as a fertiliser. Solid wastes and sludges that cannot be recycled or reused should be disposed of at an approved putrescible material landfill site. Contact your local government office for further information.

**Irrigation to land**

51. Generally, land application for the benefit of trees, crops or pasture provides an efficient means of using treated wastewater, along with the wastewater’s nutrient and organic components. The nutrients in wastewater most likely to be utilised by plants are carbon, nitrogen, phosphorus and potassium. Their full use is the goal of wastewater irrigation schemes.

52. Prior to applying treated wastewater to land a Nutrient and Irrigation Management Plan (NIMP) should be prepared for the property. For information on preparing a NIMP refer to the Water Quality Protection Note *Nutrient and Irrigation Management Plans*. Information on wasteload models for estimating sustainable loading rates of effluent to soil is available from the Department of Environment.
53. In association with the NIMP a soil survey should be conducted to determine the suitability of the soils for different types of irrigated agriculture. Soils should have the following characteristics:
   a. a structure that permits air movement and water penetration;
   b. sufficient depth to the watertable to permit optimum root development by the vegetation;
   c. adequate natural drainage or suitable artificial drainage;
   d. sufficient capacity to hold water for plant use between successive irrigations;
   e. nutrients and trace elements in sufficient quantities for adequate plant growth;
   f. suitable sodium and phosphorus adsorption ratios;
   g. moderate pH (neutral to slightly acidic soils are best for most irrigated crops);
   h. suitability for cultivation (e.g. irrigated pasture or crop production); and
   i. able to withstand cultivation without incurring significant erosion, dust problems or major structural declines.

54. The most satisfactory soils for efficient irrigation range in texture from sandy loam to clay loam (these accept irrigation water of five to ten millimetres per hour). They are generally preferred to highly permeable sandy soils and heavy clay soils. Problems of soil permeability will also increase when the sodium adsorption ratio approaches 10.

55. Additional factors to consider in determining the suitability of land for irrigation include the climatic conditions, topography of the land, ground cover, vicinity to groundwater and surface water resources, the hydrology of the site (e.g. direction and speed of groundwater flow, dilution rates and watertable levels) and susceptibility to flooding, waterlogging, and surface water runoff.

56. To ensure that an irrigation system is designed correctly the grower should consult an irrigation specialist. The specialist should provide an irrigation plan complete with design parameters and operating characteristics detailing the irrigation methods, application rates and scheduling.

57. Treated and stabilised wastewater used for irrigation should be routinely tested and applied at appropriate rates to avoid environmental problems including water-logging, salt build-up, soil toxicity, and excessive loss of nutrients. Wastewater with high BOD should be applied at rates that will not cause the development of anaerobic conditions. For information refer to the Water Quality Protection Note *Irrigation of Vegetated Land with Nutrient Rich Wastewater*.

58. The intensity and depth of irrigation should be adapted to the soil and vegetation to prevent excessive leaching of wastewater beneath the root zone. Using small quantities of treated wastewater frequently as required and applying during periods of low rainfall is recommended. Resting periods between applications may be required to permit re-aeration of the soil and minimise leaching of salts from the soil profile. When the soil is saturated, irrigation waters will need to be stored until the soil is suitable for irrigation.

59. Waterways and wetlands within irrigated land should, where possible, not be altered from their natural flow path and state. Any drainage channels should be properly located and designed to reduce the risk of erosion and minimise nutrient transport. Local native vegetation should be maintained or reintroduced, along stream banks, around wetlands, to slopes and on degraded land.

60. Treated wastewater release points should be situated with maximum separation distances from sensitive environments and residential areas. Spraying treated wastewater should be avoided near residential areas or contained on-site and surrounded by a non-irrigated vegetation buffer zone where possible.

61. Ponding of irrigated waters should be avoided. Wastewater irrigation may yield a tailwater discharge which will ultimately need to be disposed of in an environmentally sensitive way. Discharge of wastewater directly into surface or groundwater areas is not recommended.
Monitoring and reporting

62. Monitoring the plant’s performance in relation to conserving water, minimising chemical use and effluent output, wastewater treatment and recycling/reuse of waste products is important. Monitoring should be followed by performance assessment and remedial action if necessary.

63. Analysis and characterisation of wastewater output should be undertaken to benefit management of an enterprise and for adequate assessment of any land application program. Concentrations of nutrients, total dissolved solids, salinity, organic matter, BOD, suspended solids and pH should be recorded. Samples should be analysed using accredited procedures (eg. ASNZS 5667 - 1998) and laboratories (eg. NATA accreditation using ‘Standard Methods for Examination of Water and Wastewater APHA AWWA WEF’).

64. Frequency of monitoring will depend on the scale of the operation and the waste load. Monitoring data should include:
   a. the plant’s daily water usage and chemical cleaning agent usage;
   b. key waste stream indicators monitored on a weekly basis;
   c. the volume and characteristics of wastewater before and after treatment (ie. treatment plant performance) monitored daily to weekly;
   d. the volume of treated wastewater discharged to irrigated areas monitored weekly;
   e. the health of crop or pasture plants, soil chemistry, structure and water balance monitored at the end of the irrigation season;
   f. key quality parameters in run-off from the property monitored quarterly during flow events; groundwater level and quality monitoring within the irrigation area monitored quarterly; and
   g. the environmental values of relevant local surface and groundwater bodies monitored monthly to quarterly.

65. Acceptable effluent volume monitoring methods include hours-run meters linked to pump performance graphs, magnetic, ultra-sonic (Doppler), orifice plate or mechanical flow meters. Monitoring bores should be used to assist in monitoring groundwater depth and quality and should be operated in accordance with the Water Quality Protection Note on Groundwater Monitoring Bores. Tensiometers or neutron probes which monitor water penetration of the soil may be used as a tool to plan appropriate water application rates or initiate irrigation cycles. All equipment should be regularly maintained and calibrated for accuracy.

Accidents and emergency response

66. A contingency plan for the dairy processing plant should be developed, outlining management responses to various abnormal operating situations. The contingency plan should be regularly reviewed. Employees, or any person who performs tasks on the premises, should be trained and assigned roles in emergency management procedures and techniques.

67. Plants should be prepared for disruption to power supplies, human error, disruption by storms, flooding, breakdowns including drain blockages and pump failures, variable loading of the effluent treatment and disposal system and spillage of chemicals.

68. The local Department of Environment regional office should be notified, as soon as possible, of any significant chemical spill or leakage to the environment where there is the potential to contaminate surface water or groundwater.
More information

We welcome your views on this note. Feedback provided on this topic is held on file no. 18493. The note will be updated periodically as new information is received or industry/activity standards change. Updates are posted on our current Internet site <www.environment.wa.gov.au>.

If you wish to comment on this note or require more information, please contact the Water Source Protection Branch at our Hyatt offices in East Perth. Phone: (08) 9278 0300 (business hours); fax: (08) 9278 0585; or E-mail: use the <feedback> section at the Internet address <www.environment.wa.gov.au> citing topic.

The former State Government agencies Department of Environmental Protection and the Water and Rivers Commission are presently being combined to form the Department of Environment (DoE). The process will not be complete until enabling legislation has been passed by Parliament and proclaimed. This note aims to provide a generic ‘combined agency’ position on the nominated topic.

For our regional office contact details - See our Internet site: <www.environment.wa.gov.au> - About the Department, refer to the White Pages phone book business listings or phone our head office in East Perth on 9278 0300 for regional office contact details.

Appendix A. - References and further reading

1. National Water Quality Management Strategy - ANZECC and ARMCANZ
   a. Australian drinking water guidelines 1996;
   b. Australian and New Zealand guidelines for fresh and marine water quality 2000;
   c. Effluent Management Guidelines for Dairy Processing Plants 16b 1995;

2. Department of Environmental Protection / Water and Rivers Commission documents (refer to Internet site: www.environment.wa.gov.au)

   2.1 Policy and Position Statements:
   b. Environmental management for animal based industries – Dairy farm wastewater 1998;
   c. Guideline for Controlled Waste Carriers 2004;
   d. Guideline for Controlled Waste Generators 2004;
   e. Guideline for Controlled Waste Treatment or Disposal Sites 2004;
   f. Guidelines for direct land application of biosolids and biosolid products 2002;
   g. Position statement – Urban stormwater management in WA 2003;
   h. Position statement – Wetlands 2001;
   i. River restoration manual – A guide to the nature, protection, rehabilitation and long-term management of waterways in Western Australia;

   2.2 Water Quality Protection Notes:
   a. Animal industry wastewater ponds;
   b. Industrial sites near sensitive environments;
   c. Irrigation of vegetated land with nutrient-rich wastewater;
   d. Land use compatibility in Public Drinking Water Source Areas;
   e. Mechanical equipment washdown;
   f. Nutrient and irrigation management plans;
   g. Overview on protecting Public Drinking Water Source Areas;
   h. Ponds for stabilising organic waste;
   i. Private water supplies;
   j. Soil liners to contain low hazard waste.
2.3 Water Notes:
   a. WN4 Wetland buffers;
   b. WN8 Habitat of rivers and creeks;
   c. WN10 Protecting riparian vegetation;
   d. WN11 Identifying the riparian zone;
   e. WN12 The values of the riparian zone;
   f. WN20 Rushes and sedges;
   g. WN23 Determining foreshore reserves.

3. Department of Agriculture Farm Notes:
   a. 39/98 Managing nutrients on irrigated pastures;
   b. 44/97 Subcatchment management plans;
   c. 41/99 Water quality for dairying [Reviewed Sept 2000];
   d. 42/99 Cleaning and sanitising a milking plant [Reviewed Sept 2000];
   e. 53/98 Disposing of milk [Reviewed Sept 2000];
   f. 65/96 Soil management options to control land degradation;
   g. 103/00 Environmental management systems for agriculture.

4. Other publications:
   a. Agriculture Department WA – Agricultural composting handbook;
   b. Agriculture Department WA – Preparing farm chemicals;
   f. Environment Protection Authority NSW 1995 The utilisation of treated wastewater by irrigation;
   g. Environmental Protection Authority Victoria 1997 Environmental Guidelines for the Dairy Processing Industry;
   h. NZCP 1998 Farm Dairy Code of Practice. NZ Dairy Board Quality Section;

**Appendix B. - Sources of Waterborne Waste**

<table>
<thead>
<tr>
<th>Dairy processes</th>
<th>Sources of waste</th>
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<tbody>
<tr>
<td><strong>Preparation stages</strong></td>
<td></td>
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</table>
| Milk receiving/ storage | - Poor drainage of tankers  
- Spills and leaks from hoses and pipes  
- Spills from storage silos/ tanks  
- Foaming  
- Cleaning operations |
| Pasteurisation/ ultra heat treatment | - Liquid losses/ leaks  
- Recovery of downgraded product  
- Cleaning operations  
- Foaming  
- Deposits on surfaces of pasteurisation and heating equipment |
| Homogenisation | - Liquid losses/ leaks  
- Cleaning operations |
| Separation/ clarification (centrifuge, reverse osmosis) | - Foaming  
- Cleaning operations  
- Pipe leaks |
| **Product processing stages** | |
| Market milk | - Foaming  
- Product washing  
- Cleaning operations  
- Overfilling  
- Poor drainage  
- Sludge removal from clarifiers/ separators  
-Leaks  
-Damaged milk packages  
-Cleaning of filling machinery |
| Cheese making | - Overfilling vats  
- Incomplete separation of whey from curd  
- Using salt in cheese making  
- Spills and leaks  
-Cleaning operations |
| Butter making | - Cleaning operations  
- Produce washing  
- Vacreation (reduced pressure pasteurisation using steam) and salt use |
| Powder manufacture | - Spills of powder handling  
- Start-up and shut-down losses  
- Plant malfunction  
- Stack losses  
-Cleaning of evaporators and driers  
-Bagging losses |
Appendix C – Flow Diagram of Potential Wastewater Treatment Options for a Small Scale Dairy Plant

- Process Plant
- Truck Wash Down and Other Sources
- Balance Tank
- pH correction
- Solids Separation
- Chemical Clarification
- Storage
- Landfill
- Composting
- Reverse Osmosis
- Anaerobic and aerobic biological treatment systems:
  - Lagoons
  - Biofilters
  - Activated sludge
  - Dissolved air flotation

- Recycle (if pathogen free)
- Sewer (if available)
- Land Application/Treatment
- Crops, evaporation, or pasture and trees