Winery wastewater management by small wineries

A summary of learnings and recommendations from the Winewatch wastewater project

1. Introduction

Within the Margaret River wine region there are 41 small wineries (crushing between 10 and 500 tonnes of grapes) making wine on-site in 2010. Wastewater treatment and disposal methods being used include: direct discharge into a swale/drain/soil/percolation pond; discharge to one or more sumps followed by disposal to ponds/leach drains/woodlot/soil; and small treatment systems with disposal to woodlot/soil.

Table 1: Number of enterprises producing wine on-site in the Margaret River wine region

Winery crush in tonnes	Number of wineries
0 - 99	17
100 - 199	11
200 - 299	3
300 - 399	4
400 - 499	6
500 - 2,499	15
2,500 – 5,000	1
5,000 – 10,000	1
Total	**58**

Table 2: Wastewater disposal methods being used by small wineries in the Margaret River wine region

Wastewater disposal method	Leach drains	Ponds	Soil infiltration	Irrigation	Unknown	Total
Number of wineries	16	7	11	4	3	41

2. Principles guiding best practice wastewater management by small wineries

- The volume and timing of wastewater produced by small wineries in the Margaret River wine region allows for the possibility of immediate disposal of untreated wastewater to land or subsurface disposal, therefore reducing the need for storage and treatment.

- For disposal of untreated winery wastewater to be acceptable, all potential environmental and social risks need to be addressed in planning and management of the disposal site. That is, the site needs to be suitable for the disposal method, and wastewater management designed and managed to minimise potential risks.

- Disposal of untreated winery wastewater to freshwater aquatic ecosystems is environmentally unacceptable. The high biological oxygen demand of untreated wastewater can deplete oxygen when discharged into water, leading to the death of fish and other aquatic organisms.

- Wastewater end use or disposal options should be evaluated before determining treatment requirements as the end use or disposal method will often dictate the treatment needs.

- It is not possible to be prescriptive when advising wineries on how to treat and use or dispose of wastewater. Various factors will influence potential management options including whether there is a need for pre-treatment before disposal. Determining factors include wastewater volume, land availability, landform, soils, depth to groundwater, and distance from waterways, neighbours and places frequented by the public.

- The level of environmental risk will determine the level of on-going management and monitoring required.

3. Monitoring wastewater volume

It is highly recommended that wastewater volume be monitored and recorded throughout the year. Monitoring of wastewater volume is an essential tool in wastewater planning and management, as well as allowing measurement of water use in the winery. Developing or upgrading a wastewater management system without accurate knowledge of wastewater volumes is very difficult and is likely to result in either the development of a system that is not large enough and therefore doesn't work as planned, or that is much larger and more expensive than it needs to be.

Magnetic flow meters are recommended for measuring winery wastewater volumes as they are accurate and low maintenance, as well as being able to measure wastewater containing solid materials that would normally block traditional mechanical meters. However, they are an expensive option for small wineries. A less expensive option is a calibrated pump hours run meter. If wastewater is not pumped to the treatment and/or disposal area then this option is not appropriate and inexpensive options are limited. Metering of the water supply into the winery may be appropriate in some cases to give an estimate of wastewater volumes. This method will need to take into account water used in the winery that does not drain to the wastewater system as well as any stormwater that drains to the wastewater system.

4. Cleaner production measures in the winery

Reducing organic, nutrient and salt loadings, and the volume of wastewater is an important measure in minimising the risk of environmental and social impacts associated with wastewater disposal. **It is often easier and cheaper to make changes in the winery than to upgrade or replace treatment and/or disposal systems.**

Reduction of salt loadings is very important as salts in the wastewater cannot be reduced through treatment and can have negative consequences at the disposal site. The amount of sodium in winery wastewater is high relative to amounts of calcium and magnesium. This ratio is known as the sodium absorption ratio (SAR). Wastewater with a high SAR may induce **soil sodicity** at the disposal site. Sodicity causes swelling and dispersion of clay particles and can result in reduced soil macroporosity and aeration, reduced water availability for plants, reduced soil permeability and waterlogging (Chapman, Baker, and Wills, 2001). **Reducing sodium levels in winery wastewater through minimising use of caustic is highly recommended.**

Keeping lees and bentonite out of leach drains and ponds is highly recommended. This will increase the life of leach drains and may reduce odour issues associated with ponds.

If lees are disposed of to compost rather than to the wastewater system it is recommended that composting occur on a hard surface in an area that is well away from drainage lines and areas with high water table. The Shires of Augusta-Margaret River and Busselton recommend that marc be composted on a hardstand area of compacted limestone at least 300mm thick and have a bund around its perimeter sufficient to contain all rainfall from a 1 in 100 year storm event (2.78cm over 72 hours) unless the site contours enable such containment. The Shires and the Department of Conservation and Environment recommend that leachate from marc and other organic solids should be stored for re-use or drain to a wastewater management area.

See *Winewatch Fact Sheet 2: Reducing winery wastewater volumes and pollution loads* for more information.

5. Disposal methods

5.1 Leach drains

Leach drains designed using domestic criteria and used for winery wastewater have been known to develop problems after only a few years. There are a number of reasons for this including:

- The type and concentration of organic matter likely to be found in winery wastewater differs significantly from domestic wastewater (see Table 3). The concentration of organic matter is much higher in winery wastewater than in domestic wastewater. Much of this organic matter is in a dissolved form and includes organic acids, sugars and alcohols. Kumar and Christen, 2009 demonstrated that 84% of the organic load in winery wastewater was in dissolved form. Total dissolved solids are particularly high during vintage. Winery wastewater is also higher in suspended solids than domestic wastewater and has a lower percentage of settleable solids at 15 to 25% compared to domestic wastewater with 70 to 80% settleable solids (Storm,

2001). **Solids and organic matter in the wastewater may result in leach drains clogging and generally have a negative impact on permeability at the leachfield site.**

- **Lees, bentonite and diatomaceous earth will impact on soil permeability at the leachfield site.** Bentonite particles, because of their colloidal size (generally less than 0.002 mm in diameter), tend to remain in suspension, unless natural agglomeration occurs or a cationic flocculent is added to produce the coalescence and settling of negatively charged clay particles (Storm, 2001). However, bentonite tends to flocculate and precipitate in the soil surrounding the point of disposal and in doing so will reduce the hydraulic conduction of the leach drains. Investigation of clogged leach drains at a winery in the Swan Valley revealed the drains surrounded by a thick layer of impermeable material. The winemaker described it as like a concrete casing around the leach drains.

- The use of sodium hydroxide (caustic soda) for cleaning in the winery often leads to wastewater having a high SAR. **Wastewater with a high SAR may cause swelling and dispersion of clay particles and can result in reduced soil permeability at the disposal site** (Chapman *et al*., 2001).

- Winery wastewater volumes may be significantly higher than domestic wastewater volumes for at least part of the year.

Table 3: Typical composition of winery wastewater and untreated domestic wastewater (Source: National Water Quality Management Strategy, 1998 and Crites and Tchobanoglous, 1998)

	Winery wastewater mg/L		Untreated domestic wastewater mg/L
	Vintage	**Non-vintage**	
Total organic carbon	1000-5000	1000	80-290
Biological oxygen demand	1000-8000	<1000-3000	110-400
Total suspended solids	100-1300	100-1000	100-350
Total dissolved solids	<550-2200	<550-850	280-850

Adequate tank capacity, keeping lees and bentonite out of the wastewater system, and resting through use of duplicate leachfields are all essential for successful disposal of winery wastewater through leach drains. Leach drains need to be designed to accommodate the high volumes expected during vintage and the high organic composition of the wastewater.

For more information see *Winewatch Fact Sheet 4: Subsurface disposal of winery wastewater for small wineries*.

5.2 Ponds

In the Margaret River wine region where the rate of evaporation is similar to rainfall the majority of wastewater in ponds, if not used for irrigation, is lost through percolation. A very large surface area would be required for significant loss to evaporation.

Risks associated with ponds include:

- Ground and surface water pollution resulting from seepage or overflow.
- Malodour.

The level of risk will vary between sites depending on the size of the winery, nutrient levels in ponds, the permeability and phosphorus retention capacity of the soil, the presence of sandy layers, depth to groundwater, groundwater hydrology and distance to surface water.

Percolation/evaporation ponds are not recommended as a disposal method for winery wastewater due to their potential to cause ground and surface water contamination.

Simple management actions can be undertaken to minimise odour from ponds and improve biological treatment. A pH of 6.5 to 8.5 is recommended to optimise beneficial microbial activity and control hydrogen

sulphide emissions. Microbial activity in the pond can also be optimised through adjusting the ratio of carbon to nitrogen to phosphorus.

For more information see *Winewatch Fact Sheet 5: Ponds for percolation/evaporation and storage of wastewater from small wineries*.

5.3 Irrigation

Disposal of untreated winery wastewater via irrigation may provide an acceptable management option for a small winery. Studies have demonstrated that microbial populations in the soil rapidly absorb and metabolise the organic substrates contained in the applied winery wastewater (Chapman *et al*., 2001; Kumar *et al*., 2006) Nutrients in the wastewater may be taken up by plants and volatilised to the atmosphere. For this disposal method to be environmentally acceptable careful planning and management of the site is essential. This includes choosing a suitable site, calculating the required area of land, ensuring even distribution of wastewater to the site and managing risks associated with soil degradation and infrastructure breakdown. Annual soil testing should be undertaken to assess whether sodic wastewater is resulting in soil dispersion. For further detail see *Winewatch Fact Sheet 3: Winery wastewater disposal to land from small wineries*, *Winewatch Fact Sheet 6: Case study – Disposing of winery wastewater from a small winery using irrigation* and *Department of Agriculture and Food WA Farmnote 386: Identifying dispersive soils.*

5.4 Soil infiltration

Many small wineries dispose of untreated wastewater to a small area of poorly vegetated land. Potential environmental impacts of disposal by soil infiltration in this way include:

- Sodic wastewater may degrade soil structure and lead to decreased soil permeability and increased risk of waterlogging, malodour and run-off.
- Ground and surface water contamination through leaching and run-off.
- Plant death resulting from saline/acidic wastewater and nutrient toxicity.

The impacts will depend on the size of the winery, volumes and loadings of wastewater, topography of the disposal area, distance to ground and surface water, vegetation and soil type. The level of risk may be quite high as the disposal is often not carefully designed and managed, and no monitoring of potential impacts occurs.

If disposing of untreated wastewater to land, it is highly recommended that it be done via irrigation to a vegetated area.

References

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