

Productive Grazing, Healthy Rivers

Module 6: Riparian zone management: Reducing water quality impacts of dairy cows

S. Aarons

Why look at farm management?

Grazing management activities have the potential to severely degrade the environment, particularly riparian zones and waterways. These activities include:

- Stock accessing waterways – depositing nutrients (dung and urine), consuming vegetation, destabilising and eroding river beds and banks
- Tracks crossing waterways – nutrients deposited by stock and sediment from tracks
- Nutrient management activities – nutrients lost to the environment due to inappropriate rates, timing and inaccurate fertiliser and effluent application
- Stock management – nutrients (dung and urine) lost to the environment due to the location of stock camps, stand-off areas and feed pads, night paddocks close to waterways
- Pasture management – erosion and degradation of riparian land contributing to sedimentation of waterways, due to poor management of wet paddocks prone to pugging and compaction
- Effluent management – nutrients lost to the environment due to poor design, construction and maintenance of effluent ponds.

What did we do?

The aims of this module were to a) monitor the impact of farm management activities that potentially degrade riparian areas, water quality and riparian condition on two adjacent commercial dairy farms and b) study the changes associated with improved management of the riparian zones on these dairy farms. Best management practices were developed that are likely to assist in reducing the environmental degradation associated with these practices.

Status of this Module

Complete

This module was funded for three years from January 2003 until December 2005. These research activities were supported by DPI, GippsDairy, Dairy Australia, Land and Water Australia, and the West Gippsland CMA. Additional monitoring and data analysis occurred at the research site until June 2006, as a consequence of further funding provided by DPI and GippsDairy. The project Final Report for this module has been prepared and submitted. Data from this module was presented at farmer meetings as well as national and international scientific conferences and workshops. Scientific publications are being prepared.

Productive Grazing, Healthy Rivers

Module 6: Riparian zone management: Reducing water quality impacts of dairy cows

S. Aarons

How?

Monitoring of water quality and riparian condition occurred on two dairy farms located at the base of a grazing (7-dairy and 2-beef) sub-catchment in the Upper Latrobe River Basin. The 1.7km reach of the 3rd order creek meanders through the two properties and is potentially influenced by a number of farm management activities. Long-term monitoring was initiated at this research site, in late autumn 2003, before the implementation of improved riparian management in April 2004 when the creek at the research site was rehabilitated. The willows along the waterway were cut down at the base and removed by the West Gippsland Catchment Management Authority (CMA). The site was revegetated with indigenous species of local provenance and fenced to restrict stock access. Monitoring is continuing on these dairy farms to measure the changes that occur in a fenced rehabilitated site.

Weirs were constructed in the creek at locations selected for monitoring the impact of farm management activities. Piezometers (wells) were installed in paddocks adjacent to the creek to measure groundwater. The following water and riparian measurements were taken on a weekly, seasonal and annual basis.

Water measurements

Nutrients: total phosphorus (TP), total nitrogen (TN), pH, electrical conductivity (EC), total solids (TS)

Microorganisms: *Escherichia coli*, total coliforms

Stream levels: flow, discharge

Ecological data: in-stream macroinvertebrates, stream temperature, in-stream metabolism.

Riparian measurements

Groundwater nutrients: TP, TN, pH, EC, total potassium (TK)

Groundwater levels: deep and shallow

Soil nutrients: Olsen phosphorus (P), pH, EC, Colwell potassium (K)

Ecological data: small mammals, birds, vegetation and canopy cover.



Water quality measuring point at a weir prior to willow removal.

Results

An uneven distribution of nutrients occurs on these farms, as indicated by high soil Colwell K (indicator of dung and urine deposition), soil Olsen P, and the ground-water total K measured on the upstream dairy farm. The nutrient accumulation areas measured are most likely due to nutrient deposition by cows. On the upstream dairy farm, this deposition occurred where cows congregated in the stand-off area near to the dairy shed before and after morning and night milking. Nutrients have also accumulated in riparian areas near to the creek on this farm and this is most likely due to movement from the stand-off area and dairy shed downslope, rather than from the effluent ponds, or as a result of stock or fertiliser management in this area (Figure 11).

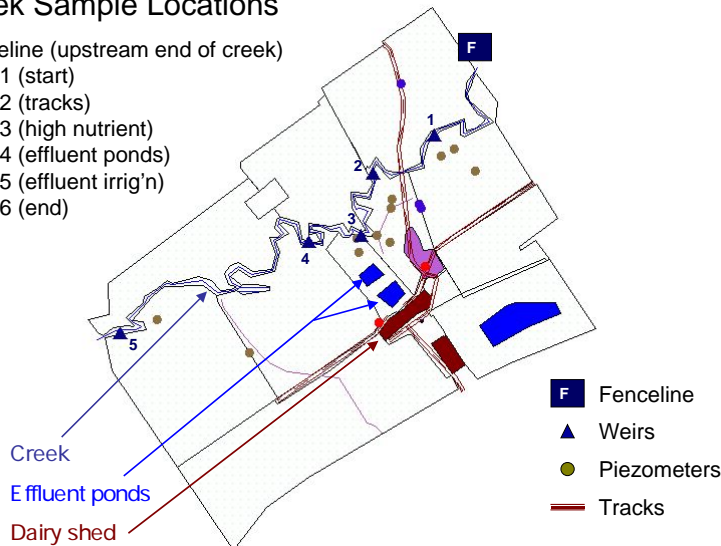


Figure 11. Research farm before willow removal. X indicates nutrient accumulation areas.

The uneven nutrient distribution on the downstream dairy farm is most likely due to the increased presence of cows in night paddocks (paddocks close to the dairy shed) and the increased deposition of dung and urine.

Creek Sample Locations

- Fenceline (upstream end of creek)
- Weir 1 (start)
- Weir 2 (tracks)
- Weir 3 (high nutrient)
- Weir 4 (effluent ponds)
- Weir 5 (effluent irrig'n)
- Weir 6 (end)



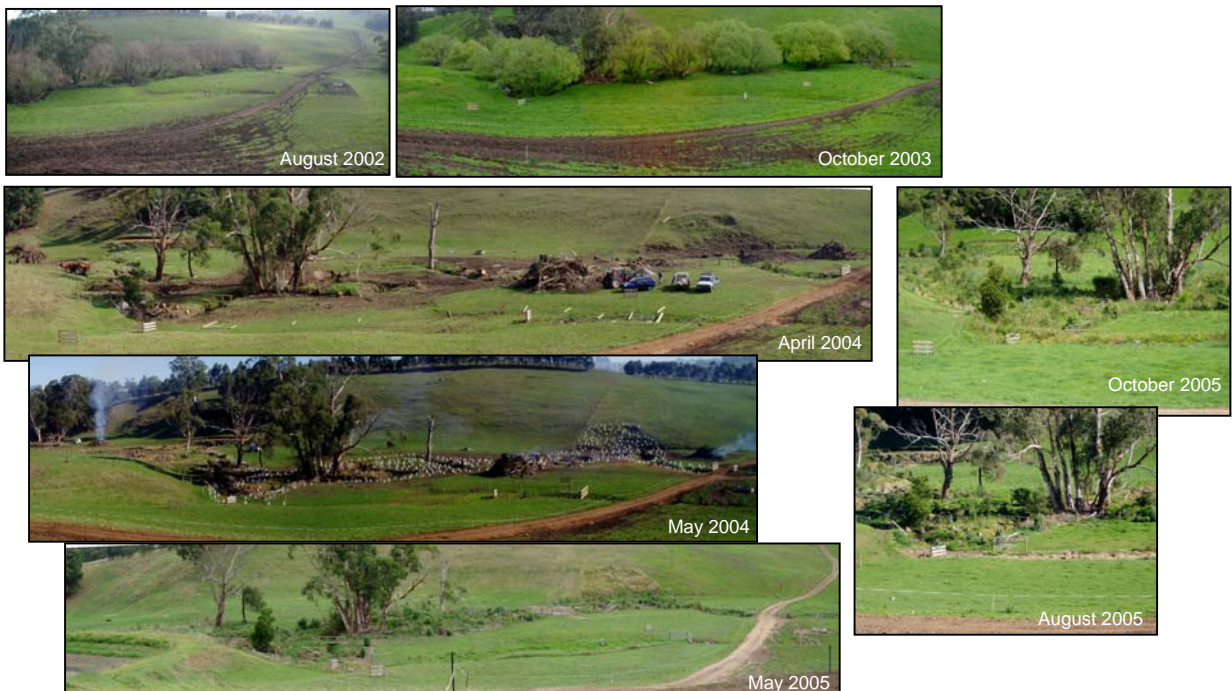
These nutrient accumulation areas have the potential to contribute pollutants to the creek, especially during times of the year with greater rainfall. Total nitrogen (TN) concentrations were statistically greater at Weir 3, which is downstream of the riparian areas with high soil nutrient levels identified above. Water visibly drains from this riparian area into the creek. The increase at Weir 3 is only observed during elevated baseflow when creek levels are higher due to greater rainfall. During summer baseflow TN concentrations are not greater at Weir 3.

Median total phosphorus (TP) concentrations in the creek are close to the EPA targets of 0.025 mg/L (75th percentile), despite the location of the monitoring site at the base of a dairy dominated catchment. Creek TN concentrations are much greater than EPA targets of 0.45 mg/L. Creek nutrient concentrations (TP, TN) were greater when stream flows were elevated than during low flow (eg. baseflow) conditions. Electrical conductivity decreased when stream flow was elevated due to greater fresh water added to the system.

Table 9. Median and 75th percentile concentrations (mg/L) of stream Total P and Total N for the research site compared with the EPA targets.

	Total P	Total N
Research Site		
Median	0.020	0.64
75 th percentile	0.030	1.00
EPA targets		
75 th percentile	0.025	0.45

Ecological assessment of the site prior to removal of the willows and revegetation indicated low terrestrial and aquatic biodiversity compared with biodiversity surveys of fenced riparian sites. Canopy cover is reduced due to removal of the willows. Steam temperature fluctuations at all monitoring points is now similar to that at Weir 4 where there were no trees prior to the removal of willows. The changes at the site indicate that the native species are growing well. Additional biodiversity monitoring will provide farmers with information about changes in birds, small mammals, vegetation and in-stream macroinvertebrates when waterways are fenced.



What does it mean?

- Management of **grazing stock** can lead to **uneven nutrient distribution** on dairy farms.
- **Pollution of riparian zones and waterways** can occur when nutrient accumulation zones are located along water flow pathways. Nutrient accumulation zones can act as point sources of pollution.
- **Grazing management** needs to be considered carefully especially where there is the potential to degrade riparian areas and waterways. The following should not be located near to waterways:
 - **Stock camps**
 - **Night paddocks**
 - **Stand-off areas and feed pads.**
- **Nutrient accumulation** resulting in elevated soil nutrient levels appear to contribute to **increased stream Total nitrogen concentrations**, most likely due to stock management activities near to the dairy shed. Reducing the time stock congregate or camp can reduce nutrient accumulation, which is particularly important if these areas occur in parts of the farm where water movement can transport nutrients and other contaminants to the environment.
- At this site, dairy farms do not appear to contribute to **high stream TP concentrations**, or, in-stream processes reduce stream TP. **Total N concentrations** are elevated, which may have implications for meeting end-of-catchment targets.
- The **increase in nutrient concentrations** during high flow conditions may be due to the contribution of nutrients in run-off or in-stream processes occurring at this time. Run-off from non-point sources may significantly contribute to stream nutrient concentrations.