Environmental Best Practice Guidelines 4. Minimising Environmental Harm from Agricultural Drainage Channels

Agricultural lands are usually drained to improve crop production. Drainage removes excess water from the soil surface and the soil profile of crop land and pasture by gravity or artificial means. This helps create a well aerated soil, which enables better uptake of nutrients by plants. Draining wet soils allows early ploughing and planting, vigorous crop growth, and better productivity. Sub-surface drainage may also be used to prevent salinity in heavily irrigated soils.

Properly planning, designing and maintaining drainage channels will minimise the likelihood that they cause environmental harm and alleviate some of their adverse effects.

1. Potential environmental effects

Agricultural drainage improves crop production but it can also cause environmental harm.

Degrades waterways: Drainage works, such as straightening channels so water moves downstream faster, can alter the morphology and function of waterways. This can trigger erosion of the stream bed and banks, and degrade aquatic and riparian habitats.

Destroys wetlands: Wetlands perform important hydrological, biological, chemical and physical functions for the environment at the farm and catchment levels. They provide temporary water storages that reduce flooding during periods of high rainfall. They provide habitat for wetland plants and animals. They act as a filter or 'sink' for sediments and nutrients moving through the catchment. Draining wetlands destroys these functions.

Drainage works can have significant environmental impacts

Increases sediment loss during construction: Constructing drains can cause increased erosion and soil transport in the surface water. The effects may be only temporary as they may diminish when the exposed soil has been revegetated and stabilised. However, the increased movement of sediment may persist if the drainage leads to greater surface runoff.

Increases erosion due to increased water velocity: Drains on sloping land can increase water velocities. This can lead to erosion of the base and banks of the drains, greater transport of sediment, and siltation downstream. Serious erosion may occur even on very low gradient slopes (1:100 or less) if there is no vegetation cover.

Badly designed drainage works can trigger serious erosion

Exacerbates flooding downstream: Improved drainage can lead to flooding elsewhere if more water enters the waterway during times of high rainfall. If the receiving waterway is unable to accommodate the extra water, flooding, erosion and habitat disturbance downstream may result. 'Solving' the flooding problem at a site by building a drainage system may cause or increase the severity of flooding downstream. Drainage may move the problem rather than solve it.

Degrades water quality: Draining land may reduce the quality of water in the receiving stream by increasing the amount of sediment, fertiliser, herbicide, pesticide, organic waste and other pollutants washed into it. The pollutants may adversely affect aquatic plants and animals, and restrict water use downstream.

Increases drain outfall erosion: Headward erosion in the base of the outfall drain may result if there is no outlet structure and there is a substantial drop between the outlet of the agricultural drain and the normal low flow level of the stream. Extensive bank erosion may result if the drainage flow goes under or around the outfall pipe or upstream headwall. The erosion may also destroy the outfall structure.

2. Environmental design requirements

Before starting drainage works a works plan should be prepared. The plan should outline the works to be undertaken and the measures that will be used to minimise the risk of causing environmental harm. The measures outlined should include those described below.

Further information on farm drainage can be found in the Drainage Information Package produced by the Department of Primary Industries, Water and Environment (DPIWE, 2002).

2.1 Seek expert advice

- Undertaking drainage works without obtaining expert advice can cause environmental harm that may be difficult and expensive to remediate.
- Professional advice will usually be needed when designing a drainage system. In some cases only a preliminary assessment will be needed. However, for larger systems detailed soil analyses, and hydrological and hydraulic design engineering advice may be needed.
- Advice should be sought from one or more experts, such as a river engineer, soil manager or hydrologist, before excavating stream beds and banks.

2.2 Plan adequately

- All relevant legislative and policy requirements should be taken into account when planning a drainage system (eg Ramsar wetland sites, threatened species, possible water pollution). See *Environmental Best Practice Guidelines 1. Legislative and Policy Requirements for Protecting Waterways and Wetlands when Undertaking Works.*
- Drainage works may increase or decrease flows on neighbouring properties. Neighbours should be notified of the proposed works and their consent obtained. This will reduce the likelihood of legal action being taken to remedy flood damage or perceived changes in water availability.
- Existing elements of the drainage system, such as natural channels, wetlands and riparian vegetation, should be preserved. If possible, drains should be designed to follow the existing drainage lines in well defined depressions.
- The land capability should be determined. Will the slope of the land sustain the drainage proposed? Does the design need to be changed to minimise the risk of causing environmental harm?
- The soils should be analysed to make sure they can sustain the drainage proposed. Some soils are more prone to erosion than others. Specialised drainage systems may be needed for dispersive, saline or sodic soils and where acid-sulphate soils may occur.
- The drainage capacity must be adequate. The likelihood of floods and the extent of waterlogging should be assessed to determine whether the proposed drainage system can convey the volumes of water anticipated. Floodplain maps, if available, can help in this assessment.
- The drainage proposal must show how the drainage water will be disposed of. Disposing of good quality drainage water poses few problems. However, care must be taken to ensure that poor quality discharge water does not affect land and water supplies downstream. In these cases, the design must prevent any adverse effects. Sediment traps may be needed, or collecting and reusing the water on site may be a better alternative.

2.3 Drainage channel design and construction

- The drainage system should be constructed during the dry months to minimise muddying of the waterway downstream. The drain banks should be allowed to revegetate before water flows again.
- The drainage system should not be 'over-designed' so excessive earthworks and bank armouring are needed.
- Paddock drains should be constructed with the minimum effective gradient to avoid erosion. Flow velocities in the drain must be non-erosive: less than 0.6 metres/second in loams and silts, and less than 1.2 metres/second in clays and gravels.

- Steep drain banks (batters) should be avoided as they are more likely to erode than banks with gentle gradients.
- Open ditches should be flat bottomed rather than V-shaped to prevent scouring.
- The existing waterways should not be straightened because straightening will increase the steepness of the drainage system and increase erosion.
- Areas of bushland should be retained, particularly along drains, to slow runoff and filter stormwater pollutants.
- Grass or other ground cover should be planted in the drain to prevent erosion into the waterway. The vegetation will also hold the banks together.
- Access for drain maintenance should be provided.

2.4 Outlet design

- An outlet structure will usually be needed so the drainage entering the waterway does not erode the outfall drain and the stream bed and banks.
- The choice of outlet structure will be determined by the site characteristics. The outlet structure may be a natural depression, excavated earthen drain, pipe, rock chute, flume or drop structure. The hydraulic characteristics that should be taken into account include design flows, exit velocities, and tail-water levels in the receiving stream, and the effects of greater-than-expected flows.

Drainage line discharge should not flow unconfined across the landscape

- The smallest but most effective outlet should be installed at a number of points to reduce sediment and nutrient transport by reducing the amount of water discharged at any one point. This approach is often used in 'hump-and-hollow' drainage systems but it can also be used with more conventional open-ditch systems.
- The concrete cut-offs around the outlet structures should be large enough to prevent flows bypassing the outfall pipe and causing erosion around the structure.
- Advice on outlet structures should be sought from experts, particularly for larger drainage systems. Rivercare Engineers and DPIWE Regional Water Management Officers are good sources of initial advice and referral.

2.5 Maintenance

- Stock access to the drains should be controlled. Fencing off the drains stops stock damaging them and defecating into them. This reduces the need to de-silt the drains, which reduces maintenance costs. It also reduces nutrient levels, which restricts weed growth. The fences should be inspected regularly to make sure they have not been damaged.
- A carefully planned weed control program should be implemented annually. Using the wrong weed control methods could be expensive and make the drains ineffective. If using chemical sprays, select the right chemicals so that the weeds are controlled without killing animals, such as frogs and fish, that may live in the drain. Contact a DPIWE Regional Weed Management Officer for information on the most appropriate sprays to use. Further information is also available in the Rivercare Guidelines for Safe and Effective Herbicide Use near Water, which is available on the DPIWE website.
- Check regularly for erosion in the drains and receiving waterway. Remediate if necessary.

3. References

Noble, M. 2002. *Rivercare Guidelines for Safe and Effective Herbicide Use near Water.* Department of Primary Industries, Water & Environment. http://www.dpiwe.tas.gov.au/inter.nsf/Attachments/JMUY-5CH7M2?open

Department of Primary Industries, Water & Environment. 2002. *Drain Care.* DPIWE, Hobart. http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/RPIO-4YP9V4?open

Department of Primary Industries, Water & Environment. 2002. *Drainage Information Package.* DPIWE, Hobart. http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/EGIL-53B6GV?open

Goulburn Broken Catchment Management Authority. 2000. *Works on Waterways Notes No. 5 Drainage Outlets.* GBCMA, Shepparton. http://www.gbcma.vic.gov.au/files/Drainage%20Outlets.pdf

Rural Water Advisory Services. 1994. *DNR Water Facts: Surface Drainage.* Queensland Department of Natural Resources, Brisbane. http://www.nrm.qld.gov.au/factsheets/pdf/water/w38.pdf

These guidelines should be used in conjunction with the appropriate technical advice and literature.

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Checklist

This checklist summarises the environmental design requirements outlined in *Environmental Best Practice Guidelines 4. Minimising Environmental Harm from Agricultural Drainage Channels.* The plan of works prepared should describe the proposed works and show that the measures listed below will be used to minimise the risk of causing environmental harm during and after the works.

❑ Works plan prepared

Seek expert advice (Section 2.1)

❑ Expert advice sought

Plan adequately (Section 2.2)

❑ Legislative and policy requirements taken into account

❑ Neighbours notified

❑ Natural channels, wetlands and riparian vegetation preserved

❑ Land capability assessment undertaken

❑ Soil assessment undertaken

❑ Drain capacity adequate

❑ Drainage water will not adversely affect water quality downstream

Drainage channel design and construction (Section 2.3)

❑ Construction scheduled for dry period

❑ Excessive earthworks and bank armouring avoided

❑ Drain gradient (longitudinal and bank) will not trigger erosion

❑ Drain flat-bottomed

❑ Areas of bushland along drain retained

❑ Grass cover in drain planted

❑ Access for drain maintenance provided

Outlet design (Section 2.4)

❑ Outlet structure appropriate

❑ Smallest, most effective drainage outlets chosen

❑ Concrete cut-offs large enough

Maintenance (Section 2.5)

❑ Drains fenced off to control stock access

❑ Weed control plan prepared

❑ Erosion inspection and maintenance program prepared