

# Water notes

Water notes for rivers management



ADVISORY NOTES FOR LAND MANAGERS ON RIVER AND WETLAND RESTORATION



## Flood proofing fencing for waterways

Restricting livestock access is probably the single most important aspect of protecting our waterways. Limiting stock access to creeks and rivers allows their beds and banks to be protected by stabilising vegetation, halting stream erosion, stripping out nutrients and improving water quality. One of the most difficult problems when fencing along and across waterways is the risk of flood damage. This Water Note addresses the design and construction of fences on waterways and makes suggestions to reduce the risk of flood damage to fences.

### Benefits of fencing waterways

In controlling livestock access to riparian zones in rural areas, it is important that fences are designed so that they can withstand floods and need little maintenance.

The benefits of fencing waterways include:

- reduction in the number of stock lost in floods;
- protection of productive lands from eroding watercourses;
- a safer work environment for farmers where flood frequency is high;
- less time spent rounding up stock from waterway areas;
- improvement in the extent and condition of native fringing vegetation;
- improved habitat for native fauna and flora;
- improved water quality (with fringing vegetation acting as a natural filter) both for the environment and farming needs;

- stock having access to cleaner water via limited number of watering points;
- reduced instream erosion and siltation, by having fringing vegetation stabilise banks; and
- increased property values due to superior property appearance.

Other Water Notes which cover the protection of waterways from stock damage in more detail are Water Note 6 – Stock Crossing Points and Water Note 18 – Livestock Management: Fencing Waterways.

### Planning fences for floods

When preparing to build fences on flood prone land, the main consideration is to minimise the risk of damage. The following principles are recommended.

- It is preferable to have as few fences crossing a waterway as possible.
- Fences that run parallel to the direction of a flood are less likely to be damaged than those that span the channel and therefore are at a right angle to the direction of the flow.
- Fences that are well back from the main stream channel or floodway are less prone to damage. This is because both flow velocity and depth of flow decrease with the distance from the main channel. It follows that the more expensive or complex fencing should be located up slope from the main flood channel.
- Fences that are at a high risk of being damaged from floodwaters should be isolated from other fences on the property. Addison (1994) suggests that an ‘end strainer assembly’ be located on either side of a waterway. Thus even if the fence in the floodway fails, the main fence is much less likely to be damaged. Strainer assemblies are the most important part of a fence, and if they fail the whole fence will fail, so it is essential that they are strong enough to take the pressure placed on the fences and provide an immovable anchorage.



- Flood frequency should be taken into account in the location of fencing. For example, fencing in low lying areas may be subjected to flood waters from upstream dam overflows or regular releases. Determining how often a waterway floods can be straight forward, as landowners often will know if the streams on their property flood every winter or only irregularly every few years. The frequency and intensity of floods will be an important factor for determining the type of fencing required.
- Stream power (and thus the capacity of a flow of water to damage a fence) increases with depth and velocity of flow. Therefore, fences should be located as far upslope from the lowest point of the stream channel as possible, in order to reduce damage.
- Ensure that fence resistance to floodwaters is minimised. Addison (1994), suggests keeping the number of in-line wires to a minimum so that there is less chance the fence will catch floating and suspended debris that would otherwise increase the force of the flowing water placed on the fence. The type of wire is also important: plain wire does not hold debris to the same extent as barbed wire or wire with verticals, e.g. hinge joint, ring lock or wire netting. Also maintaining wire tension helps to promote wire vibration which assists in minimising debris load.
- Fence height is a critical factor in determining fence stability during flood events (Agriculture WA 1993). The taller the fence, the less stable it becomes during flood flows, and fences should be constructed with the least vertical height that gives adequate stock control.
- Flood resistance can also be enhanced by having the fence posts at a 45 degree angle to the flood flow rather than at a right angle to the flow. This means that there is less resistance per unit length (Addison 1994).
- The strength of a fence against floodwaters depends on the spacing, depth and type of posts. Waratah®- BHP Steel (1993) note that there are a number of factors that affect a post's resistance to overturning. Posts dug deep or well secured to the ground are also less likely to push over in a flood. A driven post is also more likely to remain standing than one with loose soil around it. The soil type in which a post stands is also important. Posts standing in dry sandy soils require less force to push over than a fence in clay soils. Posts located closer together give a fence greater resistance to flow.



Figure 1: Debris caught on a conventional star picket fence during the Moore River floods 1999. K. Griffin

### Where to locate a fence crossing on a waterway

Site selection for construction of a fence across a waterway needs careful consideration. Incorrect location or alignment of the fence can initiate or accelerate channel erosion. The fence should always be built along a straight section of the river or at the crossover point in the middle of a meander where the main flow is naturally directed to the centre of the channel. The fence should never be constructed on a meander bend as the flow typically accelerates around the outside of the meander and can cause bank scouring.

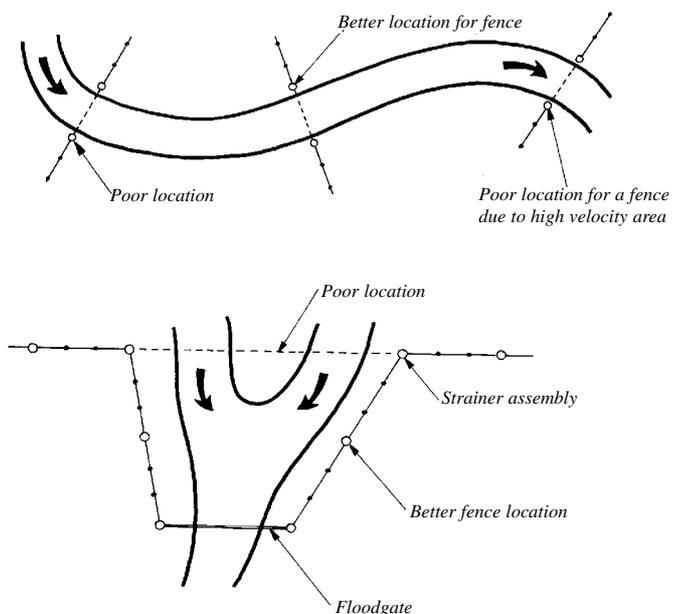


Figure 2: Location of a fence that crosses a waterway.

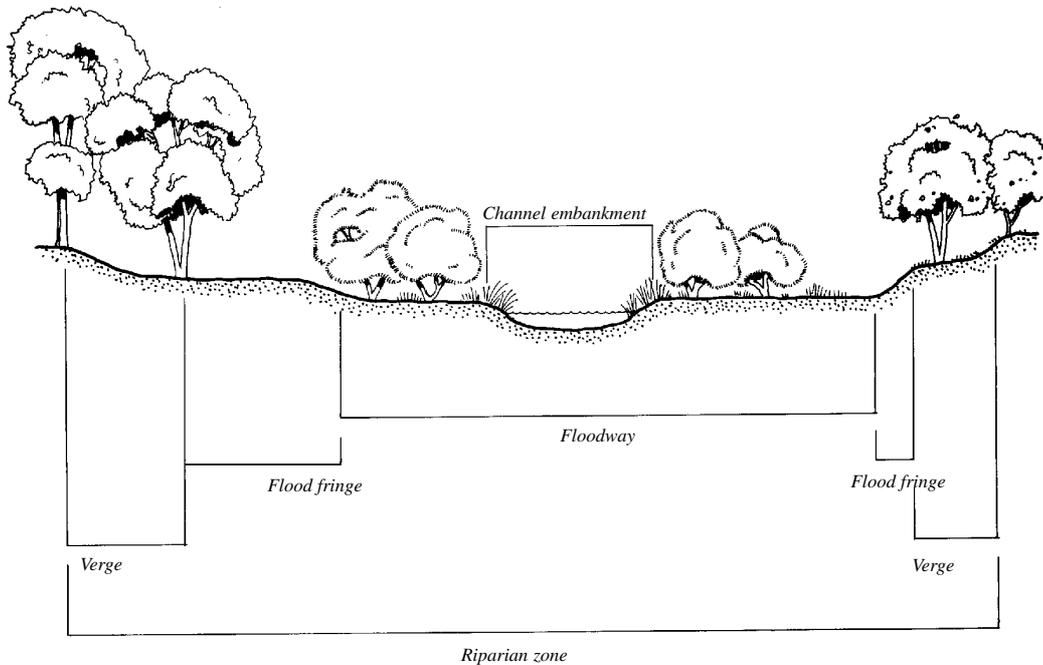


Figure 3: A waterway cross section and terms.

The selection of where a fenceline is to cross the waterway should consider the existing bed profile. The location should take advantage of naturally high points along the longitudinal profile, thus reducing the height to which the fence must be constructed and saving on materials and also reducing the fence's exposure to high stream power.

The bed material and conditions at the site should also be taken into consideration. Boggy areas should be avoided. Existing river sills or where the bed is naturally hard (e.g. laterite or clay) can be enhanced to form a more stable bank where fencing is less likely to be lost.

## Types of flood resistant fencing

### Sacrificial fencing

Studies in the eastern states of Australia (Bell and Priestley 1998; Evans 1988) have shown that conventional fences, even of heavily engineered designs, fail when installed across the path of a significant flood. This is due to the immense forces imposed by deep, fast flowing debris laden floodwaters and the build up of debris on the fence, forming a dam which eventually fails. For this reason, it is generally more cost effective and less destructive to erect sacrificial fencing across floodways. A simple star picket post and wire fence is a relatively low cost option. Due to the change in undulation, pickets across the floodplain should be spaced more closely together compared to a flatter paddock. The spacing will be determined by the actual site. To reduce the chance of debris catching on the fence, it is best to have as few pickets in the low flow

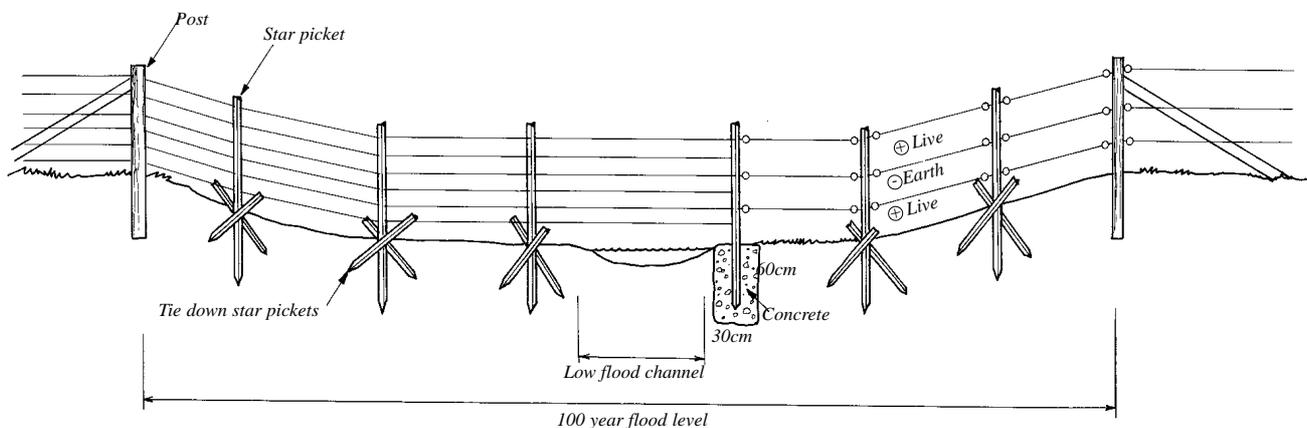


Figure 4: Sacrificial fencing example.



channel as possible and preferable to place a picket either side of the low flow channel. It is recommended that star pickets located within the floodway be braced with short “tie downs”. These consist of two 60cm long star pickets inserted at 45 degree angles at the base of the vertical picket. This will help increase the force that the fence can withstand. Conventional fencing can also include plain wire on the bottom to lift ringlock/ Stocklock®/ Hinged Joint® away from saline areas and allow flows through with little impedance. This prevents the prefabricated fencing from rusting out.

“Low level” electric fences are cheap and easy to repair if damaged by floods. An example of such a fence is shown in Figure 4. To increase the force that conventional or electric fence can withstand in a flood, star pickets can be concreted into the channel to prevent pushover or washout. However, disturbance to the riverbed is usually not recommended, as it is likely to aggravate erosion of the river channel. Tie downs are a simpler and less damaging solution. Pickets may bend with the pressure of floodwaters if secured to the riverbed and will need to be replaced.

Another example of sacrificial fencing is to have the floodway fenced with gates on either side of the river crossing. The crossing is delineated by light-weight garden mesh curtains, each suspended vertically between two horizontal wires which span the creek. The bottom wire comes away easily if a flood brings debris down. Munday (2000) suggests that although the fence has no physical strength, cattle are unlikely to challenge the mesh curtains. As the cattle are not normally in the river, their focus is to get from one side to another and the mesh curtain acts as a visual barrier.

### Drop-down fence

Fence designs which work most successfully on floodways, are those which give way under the pressure of flood flows to lay flat on the ground, and which can be re-erected after the flood (Bell and Priestley 1998). Drop-down fences can be simple to construct. A star picket or post should be dug in deeply on either side of the bank so that they will hold during most floods. A wooden dropper is then attached to the top of the star picket/post with low tensile wire and secured with high tensile wire at the base of the Star® Steel picket/post as shown in Figure 5. This allows the wooden dropper to remain attached to the base of the fence once the flood has broken the low tensile wire and the drop-down fence section is flat on the bed. Similarly, it is possible to have a drop-down strainer post which will also allow the fence to lay flat on the ground in floods. Drop-down fences require little maintenance.

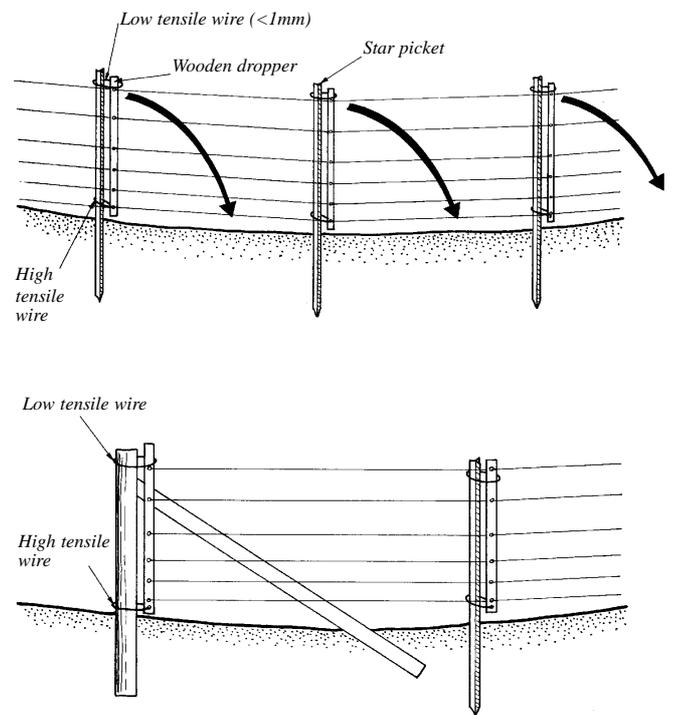


Figure 5: Drop-down fences showing star dropper and wood dropper attachment.



Figure 6: Drop-down fence being demonstrated.

### Suspended cable fences

Another successful design for fencing across valley shaped waterways is the suspended cable fence (Bell and Priestley 1998). A steel cable or chain can be suspended across the waterway between two secured posts. From the cable a fence made of galvanised chain, chain mesh, galvanised mesh or prefabricated fencing or netting is attached as shown in Figure 7. The suspended cable remains taut during the flood while the flood gate fence remains flexible and will rise with the flow. Some variations of the flood gate fence have foam or plastic floats at the bottom of the fence to aid flotation on the surface of the flood flow.

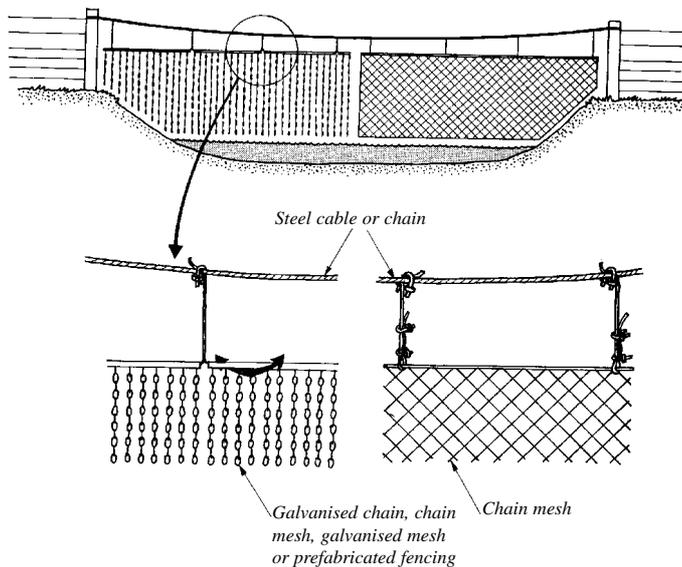


Figure 7: Suspended cable fence.

With all suspended fences, it is preferable to have as few vertical supporting posts across the floodway as possible. Debris can get trapped against the post and would cause extra pressure on the fence during flooding.

It is necessary to ensure that the bottom of the fence hangs into the water to reduce the chance of stock getting under the fence when the river dries up or the water level recedes. It is also important that vegetation such as creepers, vines and grasses do not become entangled in the fence and restrict the ability of the fence to swing up in a flood. Sediment or debris may also hold the fence down. For this reason suspended fencing needs to be checked and maintained each summer.

### Hinged flood gate

A variation of the cable fence is to have a conventional wire fence across the waterway. A cable is strung between the base of the posts on either side of the river as shown in Figure 8. A wooden or welded steel frame is hung from the cable so that it is hinged and will move up in the flow.

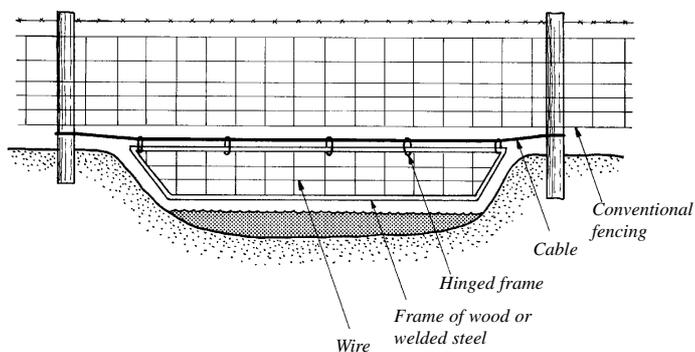


Figure 8: Hinged flood gate.

This flood gate design is only suitable if the flood flows are generally within the channel and do not normally rise above the flood gate (eg. on irrigation channels, stormwater drains or rivers below drains). In floods higher than the gate there is the risk that debris will build up on the conventional wire fence and obstruct the flow.

### Fixed frame hinged flood gate

A variation of suspended cable method for smaller waterways is to have a fixed frame across the waterway on which the flood gate fence can swing. The supporting frame needs to be well secured to the bank and if possible above the 100 year flood level. The land manager should be aware that in high flows debris may get caught on the fixed frame.

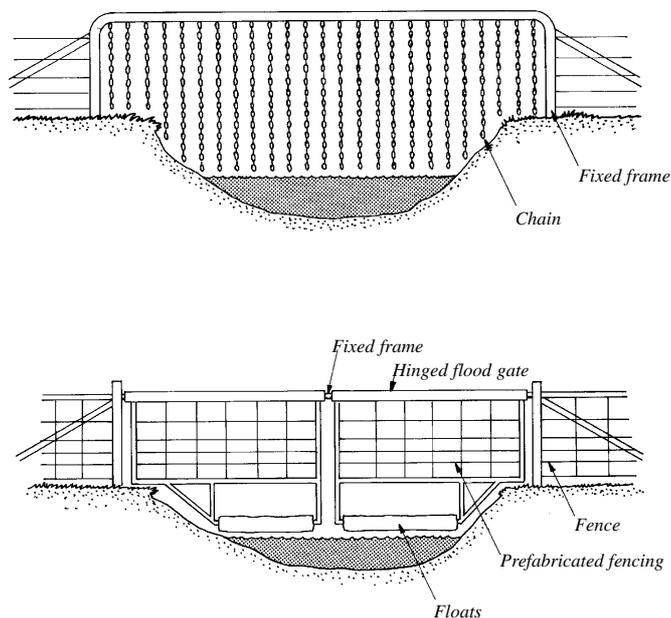


Figure 9: Fixed frame flood gate.

### Electrified flood gates

Working on a similar principle as the suspended cable fence, electrified flood gates are also ideal for use in creeks, riverbeds and other areas prone to flooding. A wire is strained between two posts (one either side of the creek). Lengths of galvanised chain at intervals of around 20 – 30cm are hung from a chain line wire. The length of the vertical chain should be kept about 30cm above the average lowest water level in the stream.

The flood gate controller (energy limiter) is connected between the fence and the flood gate. This limits the amount of power going through the flood gate during a flood so that the remainder of the fence continues to have a high voltage. Placement of a cutout switch is recommended where there is a likelihood of water levels remaining high for extended periods of time.



One innovative example of an electrified flood gate is to use dog chain, which is cheap, and can withstand several floods with no damage or debris build up. When the water reaches the chain suspended above the bed, a 'cheap' relay cuts the power which can be reset later.

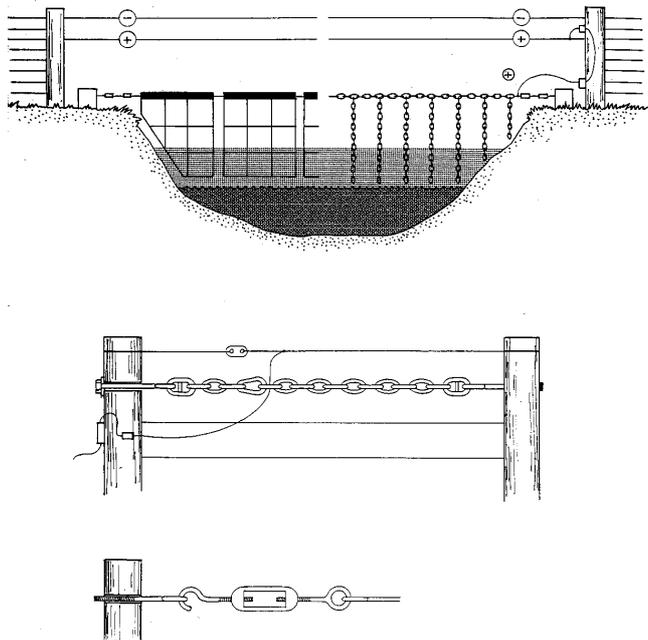


Figure 10: Electrified flood gate.



Figure 11: Electrified flood gate.

## Planning

Under the *Rights in Water and Irrigation Act 1914*, approval from the Water and Rivers Commission is required prior to undertaking works that obstruct or interfere with the waters, bed or banks of any watercourse proclaimed under the Act. Contact your local office of the Water and Rivers Commission if you are in doubt as to whether your waterway is proclaimed.

If your waterway is proclaimed under the Act, then a design plan of the fencing should be submitted to the Water and Rivers Commission if the structure will:

1. raise the height of the channel by more than 300 millimetres above the existing natural level;
2. significantly inhibit downstream flow of the river; or
3. significantly alter the natural shape of the channel.

## Timing of the works

Ideally, construction should be undertaken earlier in summer and disturbed vegetation around the crossing be reinstated prior to the following winter. The site should be monitored through winter and modified if required.

## Cost estimates for flood fencing across channels

It is difficult to estimate the cost of fencing across a river channel. The list of costs below are estimates for the cost of fencing materials for 10m of river channel. It is recognised that most landholders will have most of these materials already on the property and costs will be limited to labour. The cost of maintenance is not included and should also be taken into consideration in the overall cost.

Sacrificial fencing	\$ 45-65
Drop-down fence	\$ 20-45
Suspended cable fence (prefabricated to chain)	\$ 100-1600
Hinged flood gate	\$ 300
Fixed frame hinged flood gate (prefabricated to chain)	\$ 300-1800
Electrified flood gate	\$ 300

## Funding assistance for fencing

The cost of these fences will vary depending on the site and conditions. Part funding may be available through several funding bodies for fencing. Enquiries and applications for funding should be made through your local Waterways Management Authority, LCDC and community groups.



## Further Reading

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<http://muextension.missouri.edu/xplor/agguides>

Waratah® –BHP Steel 1993, Waratah Fencing Manual.

## Further information and technical assistance

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