MANAGING WATERWAYS

MANAGING WATERWAYS ON YOUR PROPERTY

Waterways and the riparian land surrounding them have undergone significant modification as a result of human activity. In many areas waterways are in poor condition. The modification of waterways has many unintended consequences that can severely impact productivity, social wellbeing and the environment; examples include the loss of productive farm land through erosion, and the loss of biodiversity and clean drinking through contamination of waterways by agri-chemicals, nutrients and chemical fertilisers.

Clearing riparian vegetation to make way for farm land and development, stream channel straightening, gravel extraction and de-snagging of waterways are some example of activities that can lead to widespread bank erosion, lowering of stream beds, localised flooding and the spread of willow and other invasive weeds. It is important to consider the long-term consequences of undertaking activities in and around waterways, which may be well-intended, but can adversely affect the health of waterways further along the catchment, either upstream or downstream.

SIGNS OF AN UNHEALTHY WATERWAY

Bed Lowering

Bed lowering, or bed incision, is erosion of the bed of a river resulting in a deeper channel. Bed lowering can be a natural process (we wouldn't have the Grand Canyon without it!), but accelerated bed erosion i.e. incision at a rate faster than what is considered "normal" for any given river, is viewed as an undesirable erosion problem. Bed lowering is often a precursor to bank erosion as a lowered bed leaves banks unstable. The most common process by which bed lowering takes place is the formation and upstream progression of a head cut. In essence, a head cut is a small waterfall that moves upslope as its face is undercut from the action of falling water. Head cuts are a common feature of gully erosion but can also occur in the bed of a river. Successive waves of head cut progression can significantly lower the bed of a river quickly resulting in bank collapse and channel expansion.


Head cut in top of gully, rock used to slow erosion. Photo Rick James


Two head cuts up degrading creek. Photo Rick James

Bank Erosion

Depending on the river bank erosion can be a natural process. Accelerated bank erosion is erosion above and beyond what would be normally expected for any given river. There are a number of mechanisms by which bank erosion can occur and correctly identifying the cause is essential if effective treatment is to be employed. Some causes include:

- Bed lowering: As the bed drops the "foundation" of the bank is lost. This is usually followed by bank slumping.
- Fluvial scour: The direct scouring of an exposed bank, typically on an outside bend.
- Hydraulic pressure: Groundwater seeping through the face of the bank causing destabilisation followed by slumping.
- Surcharge: The weight on top of the bank that causes collapse e.g. a large tree or building.

Depending on the site, some or all of the above may be operating.


Obvious bank erosion. The underlying cause of bank erosion must be identified if effective action is to be taken. Photo Rick James

DEALING WITH THE PROBLEMS

ISSUE	CAUSES	MANAGEMENT OPTIONS *Permits may be required to carryout certain works . For more information please see section on 'Works in and Around a Watercourse' on page 5 of this fact sheet.	PRO's and CON's
Bed Lowering	1. Disturbance of the bed e.g. de-snagging, excavating holes (gravel extraction, to create a pump hole etc.), moving gravel with an excavator or bulldozer, excessive stock access that breaks the natural armouring of bed materials. 2. Because head cuts in the bed of a river tend to migrate upstream, undisturbed reaches, or entire tributary systems, can be affected by downstream disturbance. 3. It is common for gully systems to be initiated by drainage works e.g. the channelization of a valley-fill swamp. Minor "plough lines" pulled through swampy valley-fill have often led to the formation of extensive gully systems. 4. Channel straightening. Cutting off a bend by creating a new straighter channel will result in the water flowing faster (as it now has to travel a shorter distance). Fast flowing water through a created channel with unarmoured bed material often triggers bed lowing.	1. Rock ramp bed controls are typically installed after bed lowering has taken place. The crest of the structure is built above bed level with the intention of trapping sediment upstream thereby raising the bed over time. 2. Rock lined scour pools are typically used to arrest a head cut in a gully system. 3. Timber V-weir bed control. 4. Timber or rock girdles (structures installed at bed level). 5. Re-snagging. 6. On narrow streams, stream-bank revegetation can provide effective bed control over time as the tree & shrub roots spread across the channel.	Rock structures can be expensive if suitable material is not available nearby. Construction is relatively straight forward but does require an excavator or backhoe machine. The materials for timber bed controls are usually cheaper but they are often harder to install. Re-snagging creates natural habitat as well as helping to stabilise the bed. Re-snagging will not by itself stop the upstream progression of an aggressive head cut.
Bank Erosion	Multiple potential causes any one of which, or combination of, may be operating at a particular site. The removal or damage of native riparian vegetation on the bank is usually a prerequisite factor. • Fluvial scour • Slumping • Surcharge • Bed lowering See previous section on Signs of an Unhealthy Waterway for terminology descriptions	1. Realignment & the construction of a log front wall. Revegetation of the bench created between the front wall & the eroding bank. 2. Direct protection of the bank e.g. rock revetment (sloping rock structure), log walls, pinning large woody debris against the toe of the bank etc. 3. Groyne deflection structures e.g. rock groynes, pin groynes (low wall or sturdy timber barrier), log groynes. 4. Gabion (cage containing aggregates such as rock, often used as a retaining wall) baskets. 5. Regeneration of native riparian plants by planting or facilitating natural regen-eration e.g. by excluding stock.	Where severe erosion has taken place resulting in a poor bend alignment log or rock front walls can be very effective but are expensive to install. Direct bank protection is typically much cheaper. Using tree trunks with the root ball still attached can be very effective as the root ball acts as a groyne-type structure while the trunk provides direct protection. Gabions are expensive & have a limited life span. As they break down rusty wire is washed into the channel. In all cases, the long term viability depends on the successful establishment of bank-holding native vegetation. In some instances revegetation work on its own is not enough to prevent further head-cut and bank erosion and control structures (as outlined above) will need to be installed to support revegetation or regeneration of native plants. (also see section on Energy Zones in Riparian Zones)

Assessing the causes will assist in developing a plan to address the problems

NATIVE VEGETATION AND WATERWAYS

Native vegetation plays a vital role in maintaining the health of waterways. Existing native species should be maintained and where appropriate actively encouraged to recolonise areas along waterways. This can be achieved by reducing grazing pressure using livestock fencing, allowing early colonising plants such as Silver Wattle to establish particularly in erosion prone areas. In some cases natural re-colonisation by native species is likely to be hindered by the presence of ongoing disturbance and invasive weeds. Revegetation work may need to be carried out in such circumstances and often plays an integral role in restoring the health of waterways. Establishing suitable native vegetation is particularly important in erosion-prone areas where bare ground requires immediate stabilisation. Revegetation should be carried out in conjunction with the removal of weeds, such as willow, and to support newly established erosion control structures. However it is essential that certain factors are taken into consideration when planting native plants along waterways, including the choice of species and where they are situated in and around the channel zone.

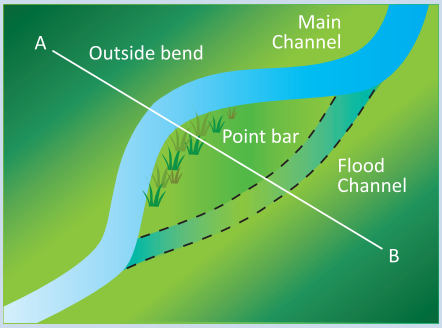
REVEGETATION CONSIDERATIONS

It is important that any revegetation work carried out within the stream channel zone takes the different energy settings into account (see 'Healthy Waterways' factsheet for more information). Some key considerations to look for are:

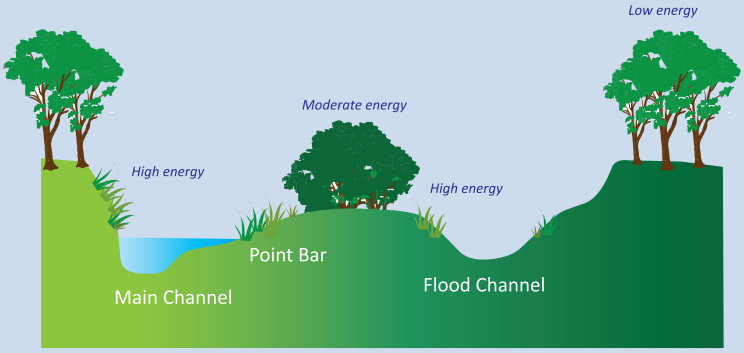
- Before carrying out revegetation works find a section of river similar to the one you propose to carry out works on, but with a good cover of native vegetation. Look carefully to work out what native plants grow where e.g. which ones seem to be able to tolerate high tractive stress? What plants only seem to grow in areas of low tractive stress?
- Plan your revegetation works around your observations – only put plants with a high tractive stress tolerance in high energy areas e.g. on the face of an outside bend.
- It is important to maintain a sufficient width of channel without the restrictions caused by larger shrubs or trees. This is required for the channel to retain its hydraulic efficiency e.g. its ability to convey flood flows. Planting large shrubs and trees on point bars, or within the flood channel zone is not a good idea as this will restrict the channel width over time.

WHAT SHOULD I PLANT WHERE?

Some plant species can hold on in the highest energy areas e.g. on the outside of a bend, while others can only grow where the energy level is low. The following diagrams show the typical variation in water energy flow across the channel of a partially confined watercourse (see 'Healthy Waterways' factsheet for more information).



River Bend on a Partially Confined River



A. Outside bend Cross Section B

The following table provides examples of Tasmanian native plants that are suitable for revegetating land adjacent to and within creeks lines and indicates where particular species should be planted, based on their ability to cope with different levels of energy flow within a waterway (see 'Healthy Waterways' factsheet for more information on river dynamics and vegetation).

ENERGY LEVEL	TYPICAL CHANNEL ZONE LOCATIONS	TYPICAL RIPARIAN PLANTS
High	• The outside of bends. • Flood channels. • Some bank attached bars. • Some mid-channel islands.	woolly tea tree (*Leptospernum lanigerum*) river tea tree *(Leptospernum riparium)* bottlebrush (*Callistemon* spp.) mat rush (*Lomandra* spp.) rushes (*Juncus* spp.) sedges (e.g. *Carex* spp.)
Medium	• Banks along straight river reaches. • The back of point bars.	blackwood (Acacia melanoxylon) silver wattle (Acacia dealbata)
Low	• Upper bank locations. • Floodplains.	black gum *(Eucalyptus ovata)* white gum *(Eucalyptus viminalis)*

*Plant Tasmanian native plants that grow in your local area. Some native plant nurseries may be able to grow native plants with longer root systems on request; these plants are grown in deep tube pots, specifically for the purpose of revegetating riparian areas.

Many species of mat rush (*Lomandra* spp.) are able to grow in areas of a stream channel that experience high energy water flows. The leafy crown offers little resistance to flood flows while the extensive, fibrous root network is highly effective at binding soil together. Lomandra longifolia can often hold fast as the bank it was growing on has eroded. It can sit in the channel in a supporting column of soil that its roots still hold firm. This is an ideal plant for revegetation work in high energy flow areas of the channel.

Stock fencing protecting new riparian plantings

LIVESTOCK AND LANDSCAPE

Livestock should be managed sensitively around waterways. Maintaining good ground cover in surrounding pasture and riparian land is key to improving the health of waterways.

- Over-use of land within a catchment can contribute to a decline in waterway health, particular where over-grazing results in poor ground cover (areas of bare ground) and compacted soil, leading to increased run off and soil erosion.
- Set a grazing regime around waterways that improves perennial vegetation cover and soil health using targeted grazing.
- Where possible use a flexible fence design, such as temporary electric fencing, near waterways. This helps to influence when and where you can graze and how long you rest the site for and can also assist planning for possible flood events.
- Knowing where your stock need to be in the next six months can influence how your riparian zone is managed as part of a planned grazing system.
- Holistic Management® Planned Grazing is one example of a management technique that can help improve ground cover and assist in reducing run off and soil erosion.
- Provide off-stream watering points for livestock. Stock should be prevented from accessing waterways, particularly in erosion prone areas.
- Retain native riparian vegetation to provide a minimum 10 metre width (buffer) upslope (away from) the top of the bank. Where no native vegetation is present, replant suitable native species, especially ground cover plants (see previous section: Revegetation Considerations). For maximum trapping of sediment, nutrient and other contaminants, combine a 10 metre riparian vegetation buffer with a grass filter strip.
- Livestock can be used to manage vegetation near waterways, for example to control woody weeds in a revegetation site, but this requires sensitive forward planning.

Top Left Eroding banks from stock access, Bottom Left Cattle excluded by fencing,
Middle Planned grazing paddocks, non grazed top paddock with weed growth.

Guide to planned grazing

WORKS IN AND AROUND A WATERCOURSE

A "watercourse" is defined in the *Water Management Act 1999* as:
'watercourse means a river, creek or other natural stream of water (whether modified or not) flowing in a defined channel, or between banks, notwithstanding that the flow may be intermittent or seasonal or the banks not clearly or sharply defined'.

STEP BY STEP PROCESS FOR WORKS

For low impact works such as tree planting and fencing, steps 1 and 2 would normally suffice. For more complex activities such as the removal of willow using machinery or the construction of erosion control structures it's advisable to follow all 5 steps below. In-stream works may require a permit from your local council or from the Department of Primary Industries Parks Water and Environment (DPIPWE).
The *Water Management Act 1999* does provide powers to require landowners to remove works from a watercourse if it is found to be done without a permit when a permit would have been required. The Water Management Branch at DPIPWE is more than happy to review proposed works and provide guidance to landowners.

Step 1: Establish Land Tenure boundary prior to works

Step 2: Seek advice from Natural Resource Management (NRM) Agencies and Local Councils

Step 3: Seek advice from a river specialist required prior to in-stream works

Step 4: Consultation with the Water Management Branch of DPIPWE
Permits may be required for the following types of works:
*Construction of battens, rock walls on banks or any structures placed in waterways, particularly those that may impede/alter current water flow, use of machinery in watercourses (including management options referred to in this factsheet)

Step 5: Consultation with your local Council planners and Environmental Health Officers to establish if a planning permits required

*Any activities that are likely to have a negative impact on native wildlife, in particular Platypus and their burrows, need careful planning and advice should be sought from DPIPWE's Policy and Conservation Assessment Branch.

In the unlikely event that disturbance or destruction (taking) of a Platypus burrow is unavoidable, a permit is required. Permits are unlikely to be issued for the taking (destruction) of a Platypus and any works must be under¬taken in such a manner that taking of a Platypus does not occur. Avoid major earthworks near or within waterways between December and April (breeding season for Platypus). If this is not practical, further advice should be sought from the Policy and Conservation Assessment Branch.

Please refer to the DPIPWE Wetlands and Waterways Works Manual for further details on working in watercourses and relevant legislation.

Willow and blackberry control at Mountain River, before and after works

MYTHS ON RIVER MANAGEMENT

Myth: Trees cause erosion

The inter-relationship between riparian vegetation and channel form is a complex one. Overall, a river with a healthy community of native riparian plants will be less erosion prone than a similar system where the plant community has been disturbed. It is true that sometimes large trees falling from the bank can leave a large area of exposed bank. Where trees lodge in the channel and deflect flows into the bank erosion can also be triggered. However, these situations where trees are implicated in the cause of erosion are more than offset by the work they do to prevent erosion.

Myth: Bank erosion can be fixed by battering the bank

Battering a steep eroding bank will do nothing to stop the erosion. The only case where this may work is when the battered bank is immediately revegetated with suitable riparian plants and these plants have sufficient time to establish before the next large flood.

Myth: Pushing gravel up against an eroding bank from the bar opposite will protect it from further erosion.

Moving gravel from the low energy side of the channel e.g. a point bar, to the high energy side – an eroding outside bend – will offer temporary protection at best. If the river had sufficient energy to move the material to the point bar then it certainly has sufficient energy to move it away from the higher energy environment on the opposite bank. The gravel will simply be washed away.

Myth: Using concrete for bed controls or bank protection is the best method.

Concrete may be hard, but it's inflexible. Water will always find a way of working around the edges of concrete structures i.e. out-flanking them. Rock structures are more flexible. The overall structure can move to fill any localised scouring while maintaining overall integrity.

Myth: Builder's rubbish, old car and truck tyres and car bodies are all cheap ways of providing bank protection.

Apart from being illegal in many cases, simply dumping rubbish over the bank is unlikely to be effective. However, clean builder's rubble can be used in the core of revetment work and is then "faced-off" with quarry rock.

Myth: Willows and other exotics are better than native plants at providing bank protection.

Willows were used extensively for river bank protection in the past. Many species e.g. Crack Willow (Salix fragilis), strike easily from simple green canes which made establishing them along river banks easy. However, this same feature also means that they can spread quickly throughout the entire system including in places where they're not wanted e.g. in the middle of the channel. In the absence of suitable native riparian plants, willow can temporally protect against erosion and stream bed lowering, but in the long-term is likely to accelerate bank erosion and cause localised flooding. Carefully selected native plants can do the same job in terms of protecting banks from erosion without any of the unintended consequences associated with the use of exotics. Develop a strategic plan for managing willows and consider factors discussed in this factsheet such as where they are positioned along a water course, such as an outside bend.

Myth: Straightening out the channel will solve the bank erosion problems.

Except in rare cases rivers don't flow in straight lines. Straightening a river increases its bed gradient as it now has to travel over less distance per unit drop in elevation. Increased gradient means faster flowing water in a created channel with disturbed bed material. The result is almost always bed incision which leads to further bank erosion.

Willow on inside bend, impacting on erosion on opposite bank

MORE MYTHS ON RIVER MANAGEMENT

Myth: Building levee banks to stop flooding is a good idea.

Levee banks trap more water in the channel during floods. This increases the energy within the channel itself and can trigger bed and bank erosion. As water leaves the channel and spreads out over a floodplain it loses energy and deposits sediment (this is how the floodplain was formed in the first place).

Myth: Vegetation and large woody debris within the channel block it up and cause flooding.

More than 10% of the channel cross-sectional area needs to be blocked before any discernible backwater effect is evident. Many "messy" or "overgrown" sections of channel are well below this figure and as a consequence the vegetation is having very little impact on the hydraulic efficiency of the channel.

Myth: Removing large woody debris(de-snagging) will help high flows get away and reduce flooding.

See comments above regarding the clearing of channels. In addition, large woody debris in the bed of a river often acts like the reinforcing bars in concrete providing extra strength to the overall bed matrix of timber, sand, gravel etc. Removing this reinforcing can lead to bed lowing problems.

Myth: Clearing trees and shrubs off the bank will help the water get away better during high flows so will help reduce flooding.

Water will flow along the face of a well vegetated river bank at approximately half the speed of a cleared one. Or put another way; if you clear the trees and shrubs from a river bank the water flowing along the bank will move twice as fast. Because of the mathematical relationship between water velocity and the energy it contains, doubling the speed (velocity) will result in the moving water having four times as much energy. No wonder cleared river banks tend to erode.

Myth: Planting trees on top of the bank will stop it eroding.

This is partly true, but if the bank is higher than about 2 meters then trees on the top of the bank are unlikely to do much to stop the toe (bottom) of the bank undercutting. Vegetation on the bank face, and at the toe of the bank are required. The one exception to this is where bank erosion is being caused by water seeping through the bank from under the floodplain. In this case trees planted back from the top of the bank can help reduce bank moisture and thus improve stability.

Myth: Allowing stock to graze river banks doesn't do any harm.

As outlined above re. the clearing of vegetation along river banks, banks kept "clean" by stock are prone to attack by fluvial scour. This process works on all the bare areas that stock cause e.g. stock tracks down the bank face, resulting in erosion problems on relatively straight reaches of a riverbank.

FURTHER INFORMATION

Price P, Lovett S. 1999. Riparian Land Management Technical Guidelines. Volume One: Principles of Sound Management. LWRRDC.

Price P, Lovett S. 1999. Riparian Land Management Technical Guidelines. Volume Two: On-ground Management Tools and Techniques. LWRRDC.

Riparian factsheets kit: http://lwa.gov.au/files/products/river-landscapes/

http://www.derwentestuary.org.au/stormwater-factsheets

Australian River Restoration Centre: http://arrc.com.au/

River Styles web page http://www.riverstyles.com/

Geomorphology and River Management: Applications of the River Styles Framework. Available from http://www.blackwellpublishing.com/

Wetlands and Waterways Works Manual: http://dpipwe.tas.gov.au/conservation/flora-of-tasmania/tasmanian-vegetation-types/about-tasmanias-wetlands/wetlands-waterways-works-manual

Guidelines for planning river care projects in Tasmania: http://nrmonline.nrm.gov.au/downloads/mql:623/content

Forestry Planning approvals http://www.fpa.tas.gov.au/

A guide to managing stock around waterways including livestock fencing:

Jansen A, Nicolson B, Askey-Doran M, Lovett S, Price P, Dean J. 2007. Managing rivers and streams in Tasmania: A woolgrowers guide. LWRRDC. Link to download: http://lwa.gov.au/files/products/land-water-and-wool/px071295/px071295.pdf

Wright D, Jacobson, T. 2000. Managing streamsides: stock control, fencing & watering options.

Link to download: http://lwa.gov.au/files/products/river-landscapes/pr061132/pr061132.pdf

Private Forests Tasmania factsheets and case studies: http://www.pft.tas.gov.au/

Tasmanian case study on gully restoration- Trees on Farms: http://www.rmcg.com.au

Glazik R, Askey-Doran M. 2004. Tasmanian Streambank Plants: a guide to common plants along streams. DPIPWE

Long-stem Planting Guide: http://www.environment.nsw.gov.au/resources/grants/longstemguide.pdf

Brock M. 1997. Are there seeds in your wetland? Assessing wetland vegetation. LWRRDC and UNE.

Willows Management Guide http://www.weeds.org.au/WoNS/willows/docs/Willows_fore_pages.pdf

Tasmanian Platypus Management Plan 2010: http://dpipwe.tas.gov.au/wildlife-management/animals-oftasmania/mammals/echidnas-and-platypus/platypus/platypus-management-plan

The List: http://maps.thelist.tas.gov.au/listmap/app/list/map

D'Entrecasteaux report: http://www.dpipwe.tas.gov.au/internnsf/Attachments/TPRY-6DT3CY/$FILE/Land_Cap_Report_DEntrecasteaux.pdf

For more information please refer to NRM South's Healthy Farming & Environment Reference Guide: http://www.nrmsouth.org.au/

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