

Environmental Best Practice Guidelines 6.

Managing Large Woody Debris in Waterways

Branches, large limbs and trees that have fallen into rivers are commonly referred to as large woody debris (LWD) or snags. LWD is a vital component of Tasmanian waterways and its removal can severely degrade their health.

'De-snagging' and the removal of vegetation for forestry and agriculture has reduced the amount of LWD in our waterways. More willows and fewer native trees in riparian areas has also led to changes in the amount and type of LWD. All three processes have reduced the richness and density of macro-invertebrates in our waterways.



Woody debris is a vital component of healthy waterways

In recent years, a better understanding of the importance of LWD for aquatic ecosystems has led to changes in the way our rivers are managed. The focus of management has shifted from widespread 'de-snagging' of streams to maintaining and re-introducing LWD into streams.

When managing LWD in waterways, the challenge is to weigh up the ecological benefits of retaining the LWD against the possible adverse changes in river level the LWD may cause.

1. Importance of LWD

Stabilises river beds and banks: LWD decreases erosion of river beds and banks by resisting and deflecting flows.

Provides fish habitat: LWD provides shelter from high velocity flows, shade, feeding and spawning sites, nurseries for larvae and juvenile fish, territory markers for migratory fish, and refuges from predation. For example, river blackfish use hollow logs in the LWD for protection while spawning in spring and early summer.

Provides niche habitat: LWD creates a range of flow conditions from deep pools to chutes and aerated water, which provide a variety of habitats for aquatic plants and animals.

Improves water quality: LWD oxygenates the water flowing over it during low flows and reduces water stagnation. This increases the availability of oxygen for fish and reduces odours.

Provides space for colonisation: LWD provides a range of surfaces, including grooves, splits and hollows, on which invertebrates, microbes and algae can colonise. These tiny organisms lie at the bottom of the food chain and provide food - directly and indirectly - for all the animals living in the stream, including macro-invertebrates, fish, water rats and platypuses.

Provides food: The dissolved and particulate organic material (carbon) from LWD is an important source of food for aquatic invertebrates and fish. For example, the giant freshwater lobster (*Astacopsis gouldi*), which is listed in Commonwealth and Tasmanian threatened species legislation, relies on decaying wood for its diet.

Supports invertebrate life cycle: Many aquatic invertebrates have a terrestrial adult stage. These species need LWD that protrudes out the water so they can emerge from the larval to the adult stage of their life cycle.

Aids re-colonisation: Scour pools formed by LWD provide pockets of habitat for aquatic species in streams with little or no summer flows. The species living in these pools provide a reservoir of species that migrate and colonise the rest of the stream when flows increase.

Provides perches: Birds, reptiles and mammals use protruding LWD as resting, foraging and lookout sites.

Provides alternative food sources: LWD may be the main source of food for aquatic animals if streams in the catchment have been extensively dammed and stripped of their riparian vegetation.

2. Re-positioning LWD

Re-positioning LWD is an option if the debris is causing detrimental variations in flow and removing it cannot be justified on economic and ecological grounds. The objective of re-positioning is to minimise the negative effects on flow while still maintaining an ecologically desirable range of flow velocities and water depths in the channel.

Potential environmental effects

Initiates bank erosion: Re-positioning LWD may initiate bank erosion by diverting flows. The likelihood that LWD will initiate erosion depends on the alignment and size of the debris, the flow velocity and depth of the river, and the composition of the bed and banks. Generally, the likelihood of erosion decreases as river size increases.

Mobilises sediment: Re-positioning LWD may increase the maximum stream velocity in the centre of the river, which may mobilise bed sediment and deepen the stream. Sometimes, relocating LWD causes more problems than leaving it in place.

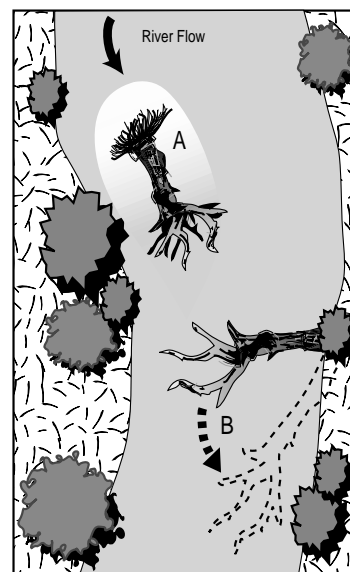
Degrades water quality: Short-term disturbance of sediment during re-alignment, and long-term erosion and mobilisation of sediment after re-alignment may degrade water quality.

Destroys habitat and food sources: Excessive re-alignment of logs closer to the bank may disturb or destroy existing aquatic habitats and food sources.

Environmental management principles

Before re-positioning LWD 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.

- Undertaking works in waterways without expert advice can cause environmental harm that may be difficult and expensive to remediate. Depending on the scale of the works, advice may be needed from one or more experts, including a stream biologist, river engineer, fluvial geomorphologist or hydrologist.
- A proposal for re-positioning LWD should be treated like any other development needing council approval. A management proposal should be prepared that justifies the project and states its objectives (supported by hydraulic calculations that show the effects on velocity and flow), evaluates the environmental impact, and specifies the intended works. All relevant agencies and interested parties should be given the opportunity to comment on the proposed works.
- Works in or near streams should adopt the principles outlined in *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands* to minimise the risk of causing environmental harm.
- Logs lying perpendicular to the flow should be rotated so they lie closer to the bank at an angle of 0-40°. This should improve the capacity of the channel to carry peak flows while retaining a reasonable variety of habitats. Placing LWD this way creates lower water levels, maintains the surface area of the debris for aquatic plants and animals, and increases the availability of low velocity habitats.
- Placing all the logs along the edge of the stream bank will improve the flow capacity but reduce the availability of slow water habitats. While the LWD should be roughly aligned to the direction of flow, it should be placed in a variety of locations and alignments so it creates a variety of habitats. It should also be arranged so it is closely spaced.
- It may be necessary to anchor the re-positioned LWD so it is not carried away during high flows.
- The works should be inspected and maintained regularly to make sure they are effective.



LWD provides feeding and refuge areas for fish and other aquatic species. Hydraulic forces around LWD contribute structural diversity to the river bed - eg upstream scour pools (A). LWD should not be disturbed unless it is shown to be causing unacceptable flooding or erosion. If action is required, re-aligning LWD nearer to the bank is preferred to removal (B).

3. Removing LWD

In the past, river management agencies and landowner groups and individuals removed LWD from rivers - often because they were concerned it could cause flooding. However, there is little evidence to support the argument that removing LWD reduces the frequency of floods or improves the capacity of rivers to carry floods.

A river channel must be blocked substantially before the movement of flood waters is affected. Such blockages are generally obvious and would usually be described as a log-jam. LWD that lies perpendicular to the flow and covers more than 10 percent of the channel's cross-section may increase the likelihood of the stream flowing over its banks during floods. Smaller LWD has little effect on water levels.

Potential environmental effects

Initiates erosion and mobilises sediment: Removing LWD reduces the resistance to flow and may divert flows. This may trigger channel instability and further erosion without alleviating the flooding problem. Removing LWD may also increase the maximum stream velocity in the centre of the river, which may mobilise bed sediment and deepen the stream bed.

Degrades water quality: Short-term disturbance of sediment during removal, and long-term erosion and mobilisation of sediment after removal may degrade water quality.

Exacerbates flooding downstream: Complete removal of LWD and riparian vegetation in the middle to upper catchment may increase flow conveyance and exacerbate flooding problems for towns and properties downstream.

Destroys habitat and food sources: Removing LWD may disturb or destroy aquatic habitats and food sources.

Environmental management principles

Before removing LWD 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.

- The preferred - and the most effective and cheapest - approach is to leave the LWD undisturbed, unless it is causing unacceptable flooding or severe erosion.
- If a log-jam is causing flooding it may be possible to re-position the tree trunks or lop the limbs. Re-positioning the fallen tree trunks so they are more closely aligned to the bank will reduce the effect they have on river levels while still maintaining their ecological benefits. Lopping the limbs to reduce the amount of debris they trap may reduce their effect on flow levels.
- Removing the LWD may be the only option if the debris is blocking a large proportion of the channel and it cannot be re-positioned, is hazardous to recreational users, or becomes trapped around a bridge and creates a safety hazard.
- Undertaking works in waterways without expert advice can cause environmental harm that may be difficult and expensive to remediate. Depending on the scale of the works, advice may be needed from one or more experts, including a stream biologist, river engineer, fluvial geomorphologist or hydrologist.
- A proposal for removing LWD should be treated like any other development needing council approval. A management proposal should be prepared that justifies the project and states its objectives (supported by hydraulic calculations that show the effects on velocity and flow), evaluates the environmental impact, and specifies the intended works. All relevant agencies and interested parties should be given the opportunity to comment on the proposed works.
- Works in or near streams should adopt the principles outlined in *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands* to minimise the risk of causing environmental harm.
- If long-lasting hardwoods are being removed, consider relocating the wood or storing it for future habitat restoration works.
- The works should be inspected and maintained regularly to make sure they are effective.

4. Re-introducing LWD

Extensive clearing of riparian and floodplain vegetation has removed the sources of LWD in many of our waterways. Even if successful stream bank revegetation has been undertaken, it may take hundreds of years to generate a new supply of LWD. Re-introducing LWD should be considered when restoring rivers to speed up their recovery. This will complement the effects of revegetating the banks and improve the river's ecological health.

Potential environmental effects

Re-introducing LWD will usually improve the river's health. However, it can cause detrimental environmental effects.

Degrades water quality: Short-term mobilisation of sediment when re-introducing LWD, and long-term erosion and mobilisation of sediment after re-introducing LWD may degrade water quality.

Destroys habitat: Re-introducing LWD can change the stream's hydraulic regime. This may lead to a loss of the plants and animals that were adapted to the previous conditions at the site.

Environmental management principles

Before re-introducing LWD 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.

- Undertaking works in waterways without expert advice can cause environmental harm that may be difficult and expensive to remediate. Depending on the scale of the works, advice may be needed from one or more experts, including a stream biologist, river engineer, fluvial geomorphologist or hydrologist.
- A proposal for re-introducing LWD should be treated like any other development needing council approval. A management proposal should be prepared that justifies the project and states its objectives (supported by hydraulic calculations that show the effects on velocity and flow), evaluates the environmental impact, and specifies the intended works. All relevant agencies and interested parties should be given the opportunity to comment on the proposed works.
- Works in or near streams should adopt the principles outlined in *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands* to minimise the risk of causing environmental harm.
- LWD loads vary according to the type of river and river reach (ranging from zero upwards). Similar healthy, unmodified river reaches in the catchment should be used as models to determine the amount of LWD needed.
- The LWD should be placed on the downstream end of outside bends and have a range of alignments. When deciding where to place the LWD consider whether access to the bank by machinery may be needed in the future, whether single objects or more complex structures would be more appropriate, how much LWD should protrude above the water, and the reduction in flow velocities needed.
- A range of debris sizes should be used to promote habitat diversity. Native species should be used rather than introduced species (willows) and artificial materials (car bodies and concrete).
- The timber used should not come from the river's banks or floodplain. Logging waste may be a suitable alternative.
- Changed hydraulic conditions may cause erosion and scouring of the bed and banks around the LWD. This is not necessarily a problem as it may increase habitat diversity. Creating a wide enough riparian buffer zone will ensure the erosion cannot damage fences and other structures further away.
- It may be necessary to anchor the LWD so it is not carried away during high flows.
- The works should be inspected and maintained regularly to make sure they are effective. The ongoing maintenance may include lopping, re-alignment and selective removal.



Re-introducing LWD can help improve stream health.

5. References

Inland Fisheries Service. 2000. *Rivercare Management, Fish and Habitat Facts: Large Woody Debris. Rivercare Management Fact Sheet No. 4. IFS, Hobart.*

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Lovett, S. & Price, P. (eds). 2002. *Riparian Land Management Technical Guidelines Volume 1: Principles of Sound Management and Volume 2: On-ground Management Tools and Techniques.* Land & Water Australia, Canberra. <http://www.rivers.gov.au/publicat/guidelines.htm>

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

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Checklist

This checklist summarises the environmental management principles outlined in *Environmental Best Practice Guidelines 6. Managing Large Woody Debris in Waterways*. 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

Re-positioning LWD (Section 2)

- Expert advice sought
- Management proposal prepared
- Works conform to *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands*
- Logs aligned at angle of 0-40° to stream bank
- Logs placed in variety of locations and alignments
- LWD anchored if necessary
- Inspection and maintenance program prepared

Removing LWD (Section 3)

- Leaving LWD undisturbed considered
- Re-positioning of trunks and lopping of limbs considered
- Expert advice sought
- Management proposal prepared
- Works conform to *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands*
- Extracted hardwoods relocated or stored for future use
- Inspection and maintenance program prepared

Re-introducing LWD (Section 4)

- Expert advice sought
- Management proposal prepared
- Works conform to *Environmental Best Practice Guidelines 2. Construction Practices in Waterways and Wetlands*
- LWD load modelled on similar healthy, unmodified reaches
- LWD placed on outside bends with range of alignments
- Native timber with range of debris sizes used
- Timber does not come from banks or floodplain
- Riparian buffer zone wide enough
- LWD anchored if necessary
- Inspection and maintenance program prepared