



*Your guide to  
managing these  
trees in Waikato  
wetlands and  
waterways.*

# Willows and Alders





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NZ Landcare Trust  
PO Box 4305  
Hamilton 3247  
New Zealand  
0800 526 322

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Written by: Karen Denyer

Edited by: Melinda Dresser and Nardene Berry, NZ Landcare Trust and Terina Rakena, Waikato Raupatu River Trust

Graphic Design: Abby Davidson, NZ Landcare Trust

Photography: Karen Denyer unless otherwise credited

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Willows and alders can form dense forests and in many places have replaced native wetland and river-bank vegetation in the lower Waikato region. Yet, if well managed, or the right species, they can also contribute to bank stability and offer positive benefits to wildlife. Willow management is complicated – there are good arguments for and against removing them, and some councils are planting *and* removing them.

### Confused?

If you've been thinking about how to manage willows and alders, this guide is for you. Produced by a group of river users, wetland ecologists, flood management experts and local iwi, it brings together a wealth of knowledge and values to help you decide what to do with willows and alders on your property.

This document includes good practice options based on current knowledge. Further research is ongoing into the effect of willow control and these guidelines may be updated in future based on the research findings.

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# 1. About willows and alders

*Willows aren't native to New Zealand, but we're all familiar with them. Picture the graceful weeping willow - shaggy mop heads pruned to perfect semi-circles in sheep paddocks. Or the twisted, gnarly crack willows that line our river banks - rows of bare skeletons in winter bursting lime green with fresh leaves every spring.*

Alders are less well known. From scattered trees in Hamilton gullies, and thin strands along the Huntly river banks, alder becomes more common downstream, forming tall, dark forests in the Waikato River delta islands and floodplains.

The main species covered in this brochure (grey willow, crack willow and common alder) can be found growing together, but tend to prefer different habitats (see map on page 3). None of them like growing in shade, so you'll mostly find their saplings in open areas or low vegetation like purei/puurekireki sedgeland or flax.

Matsudana willow has leaves very similar to a crack willow but has a different form. Crack willow (left) and Matsudana (right). Photos: Waikato Regional Council

Grey willow



Crack willow



Alder leaves and cones. Photo: Trevor James



In 1913, NZ botanist Thomas Cheeseman wrote "... alder have spontaneously appeared ... along the banks of the lower Waikato, from Huntly to within a few miles of the mouth of the river. Probably they have originated from seeds floated from Taupiri, where, I understand, it was planted by the missionaries prior to 1860. The willows which now form a continuous fringe along the banks of the river have doubtless originated from the same source".



### Willow/Whirotangi (*Salix* species)

- Deciduous trees and shrubs- about 10 species plus many hybrids and cultivars in NZ.
- Brought to NZ in early 1800s from Europe or Asia and widely planted for bank stability.
- Crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*) are very invasive and can live for 100 years. It is illegal to propagate or plant crack willow in NZ.
- Matsudana willow and its hybrids are tree willows used for shelter belts and erosion control on land and along rivers. There are also several varieties of shrub such as booth, and osier willows that are used for erosion control as well.
- In the wrong place, even non-invasive willows can block streams causing flooding, and scour stream banks.

### Common or black alder/Raakau Paakehaa (*Alnus glutinosa*)

- Deciduous tree, up 20 metres tall, can live for 160 years.
- Native to Europe, Asia and North Africa.
- Brought to NZ in the early 1800s as a shelterbelt and timber tree and for its yellow dye.
- Burns hot when still green and was used to fuel Waikato River steamboats as told by Te Puuaha o Waikato (The Port of Waikato) kaumatua.
- Tolerates wet to dry soil and fresh to slightly salty water.
- Adds nitrogen to the soil.

The map below shows the habitats willow and alder species tend to be found in.

Google map



**Good and bad willows** – All willows are useful for erosion control, both on hillsides and along rivers, but some varieties are invasive and others are not. Councils and other agencies aim to remove the bad invasive willows and plant the good willows for erosion control and aesthetic purposes, but even good willows require maintenance and sometimes need to be removed.



## 2. Effects on Rivers and Wetlands

*The Waikato region, famous for its mighty river, was also a New Zealand stronghold for wetlands - from massive bogs to tiny backwater swamps. After a century or so of land development, vegetation clearance, drainage and flood schemes to create the farmland and urban areas we live and work in, there's not much of our wetlands or natural stream-side vegetation left.*

Immense kahikatea trees (like these at Waihora lagoon) once lined the Waikato River. Most were felled for timber, and by the early 1900s non-native willows and alders had replaced them.

By the early 1900's, non-native alders and willows had become well established in the Waikato.

- Alder seeds are spread by wind and water across the Waikato River islands and floodplains, germinating in full sun or light shade on damp or dry soil, and suckering to form solid thickets.
- Crack willow doesn't produce seed in New Zealand as mostly male trees were brought here – but brittle branches or stems will quickly produce roots, and any bare site downstream of a crack willow tree is fair game for invasion.
- Grey willow, on the other hand, produces millions of seeds and is steadily marching its way through our low-nutrient fens and bogs. But it has a wide tolerance range and can also invade roadside banks and swamps. Floods or fires can open up bare ground which is perfect for grey willow to take over.

Today around a third of the Waikato's remaining freshwater wetlands are dominated by willow. To survive in this altered environment, native fish and birds have had to adapt- if the kahikatea trees your ancestors once nested in are gone, then willows or alders just might have to do. Removing willows and alders gives us a chance to restore our disappearing natural habitats, but care must be taken to make sure the native plants and animals that rely on them today will have somewhere else to live in the meantime.



### Some of the downsides to willows and alder

- Alter water flows (e.g. suck up water from small streams).
- Can block channels and worsen local flooding or stream bank erosion.
- Need regular maintenance if used for river-bank protection.
- Block water views and river access for fishing and boating.
- Snags are hazards for boaties and swimmers.
- Shade out some native plants like kahikatea and can have a very weedy understory.
- Can reduce in-stream insect abundance.
- Piles of rotting autumn leaves can pollute water in wetlands and slow-flowing streams.
- Reduce habitat for birds like pied stilts that feed in the open.
- Provide habitat for possums and rats.
- Removing them can cause other problems like bank collapse or weed invasion.

### On the plus-side

- Willows are the best plant known to provide stability to river banks and help control serious erosion. Their deep, matted roots help hold river banks together.
- Can slow down flood waters.
- Help cool streams and reduce weeds in waterways.
- Shade-loving native plants, like rare swamp astelia, can grow under them.
- Bats and shags/kawau may nest in old trees.
- Shy wetland birds like bitterns and crakes forage under their canopy.
- Eels and other fish shelter among their roots.
- Willow foliage is good drought fodder.
- Produce pollen and nectar for bees.
- Can help feed fish by providing insect habitat next to waterways

Giant native dragonfly.



Little shags and pied shags (top right) use alders for nesting or roosting along the Lower Waikato River. Photo: Nardene Berry, NZ Landcare Trust



The Motutieke Island kahikatea stand “...was the inspiration for us regards the benefit of alder as a kohanga canopy for kahikatea to regenerate on the Maurea Islands. Alder is dominant down there and ... is slowly dying out and being replaced by those kaiks. Provided they are thinned out right...they allow a lot more light to filter through to the undergrowth. The kicker of course is keeping on top of other things that like the light filtering as well like the inkweed, *Tradescantia*, *Glyceria* and yellow flag iris.” Cheri van Schravendijk-Goodman, Waikato Raupatu River Trust.



### 3. Making decisions

*So you've got willows and alders on your land? Maybe you like the look of them, or feel they are performing an important role. Or maybe you see them as a pest and want to get rid of them.*

*"We have a policy of retaining the willow trees to suppress exotic weeds and act as a canopy cover for the understory until the native canopy trees have enough maturity, but we are finding that we are gradually thinning them as they either fall over or snap off." – Mangaiti Gully Group from <http://gullyrestoration.blogspot.co.nz/>*

Mangaiti Gully Restoration Group members Rex Bushell (right) and Rod Lugton (centre) discuss willow management options with Gerard Kelly (left) from Hamilton City Council.





Before fuelling up the chainsaw or lugging out the knapsack, take a few moments to consider what it is you want to achieve.

- Look at how your site is now. Do you have a wetland chock solid with old willows or alders? Or a more natural wetland with a few scattered saplings? A row of gnarly old trees on the bank of a swift river? Or a thicket clogging a gentle stream gully? Is the understory a diverse mix of natives, or just a thick weedy mess? How would you like it to look in 10, 50, 100 years?
- Which species are you dealing with? What problems are they causing that need to be dealt with? Spreading downstream? Seeding into a natural wetland area? Toppling into the river? Shading out natives?
- What useful things (if any) might the willows or alders be doing now that you need to consider. Protecting privacy? Roosting or nesting sites for birds? Shade for water? Holding banks together? Shading out weeds?

Removing the exotics may end up damaging stream banks or killing native plants through spray drift, falling branches or sudden loss of summer shade.

**Tip:** Talk to the Regional and District Council before you do anything. They may be able to help with advice or grants.

To remove willows and alders especially on a river bank, you may need a consent or permission from one or more of the following agencies; your Regional or District Council, LINZ, and the Department of Conservation.

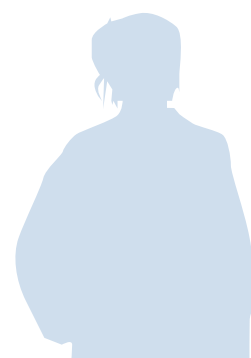
## Plan your project right through to the end

A good early step is to draw the problems and values on a map or aerial photo. Then use the management and planning tools listed under 'Useful links' at the back of these guidelines. The Ake Ake tool can help use knowledge of the past and present to create a future vision. You will need to think about the following:

- Whose land is it? Have you got their permission? How easy is it to get to?
- What do you want to achieve? By when?
- How will you do it? How much will it cost? Who can help you?
- Do you need a permit or a consent?
- If you remove willows and alders, what will you replace them with?
- Do you need any tools, skills, or qualifications (e.g. GrowSafe certification for herbicide use)?
- Are there special features you want to protect like native birds, plants, or fish?
- Talk to others – farm consultants, neighbours, experts, iwi, Fish and Game – they may have valuable tips or points of view.

Look through all the options in the table on the following page - a suitable action for one option might stop you being able to achieve another option. Try the **decision tree**, it may help you decide what to do for your situation. Later chapters provide detail on how to remove willows and alders if that's what you plan to do.

Be realistic about what you can achieve – permanent willow or alder removal from large areas might not be possible, but with perseverance you may be able to keep them from spreading or knock them back in your site.



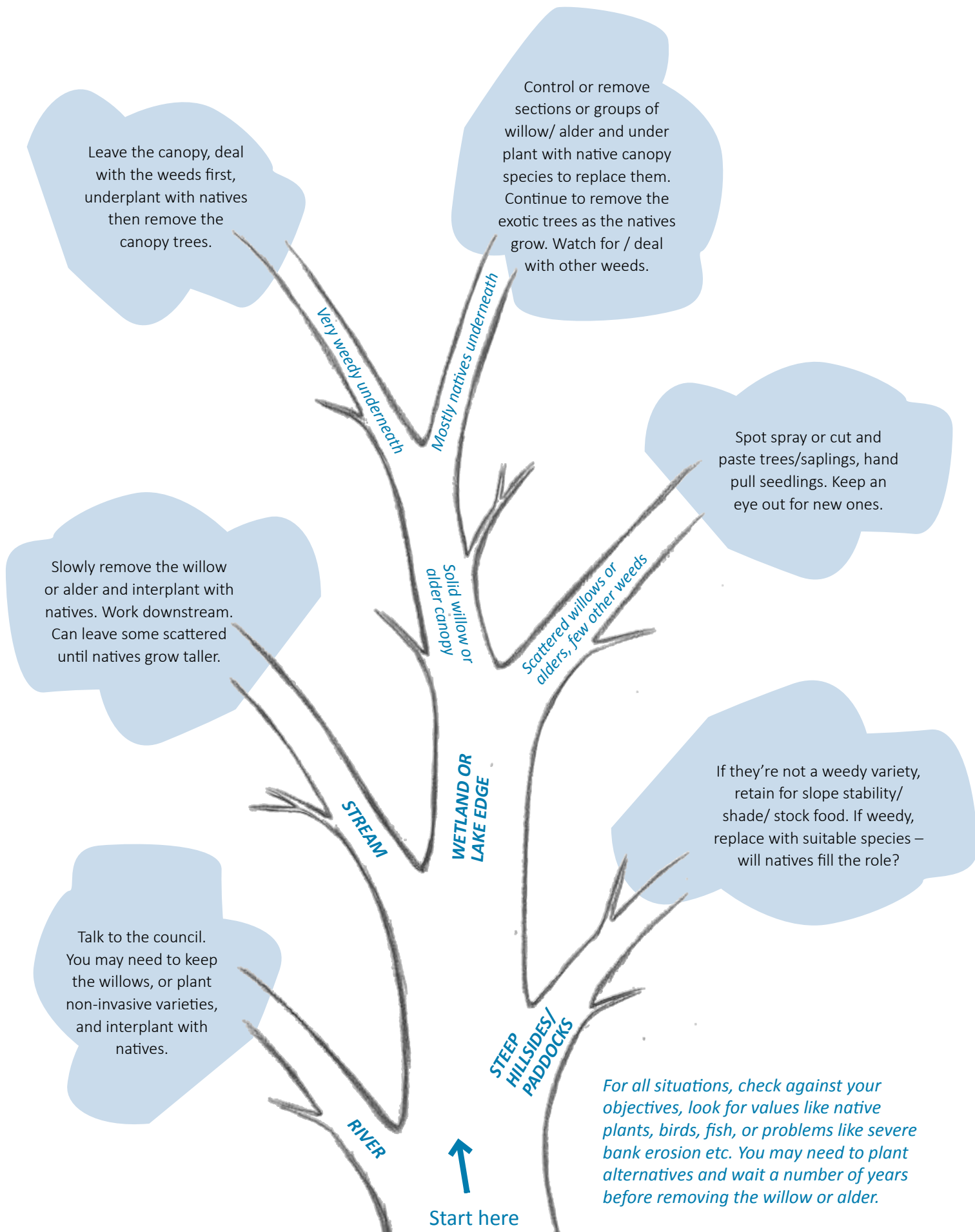
*"It all comes back to what you're managing the site for. In South Taupo we found several threatened species appeared after grey willow control. Yes the willow were going to come back in 10-15 years but it gave the threatened plants a chance to become established, reproduce and replenish the seed banks. What that really means is if you're after site eradication you need to have follow up.... Nothing new in the weed control stakes." - Kerry Bodmin, NIWA.*



## Values and options – what do you want to achieve with your site?

If you want to ...	For <b>river</b> and <b>stream</b> margins, consider:	In <b>wetlands</b> or <b>lake</b> margins, consider:
Keep river banks stable and/or protect water quality	Leave a row or two of willows and alders on the water's edge. Thin the foliage (e.g. remove lower branches) to create a light well, and underplant with cabbage trees, lowland ribbonwoods etc. Once the natives are mature, poison the exotic trees, but cut and haul back trunks that could cause blockage or endanger river users. Plant dense ground cover, Matsudana or shrub willows to slow run-off and trap sediments, and fence out stock.	Maintain dense grassy or sedge swards at the wetland edge to trap sediments. Consider building sediment ponds. Fence out stock. Underplant the willow and alder with natives then slowly remove the deciduous exotics to reduce big input of nutrients through autumn leaf fall.
Restore native vegetation	Slowly replace alders and willows by taking out groups of mature trees in autumn and planting natives underneath. Start upstream when removing crack willow and alder to reduce the chance of re-invasion.	Aerial spray large dense areas, or take out groups of the canopy trees and plant natives underneath. Stop the spread- cut down and poison the trunks of saplings spreading into natural wetlands. Hand pull or spray young trees. Fill the gap with suitable natives.
Protect / encourage native wildlife	Check for signs of wildlife, e.g. cormorant nests, bat roost holes, eels among submerged roots. If you see signs, leave a few rows of riverside willows and alders until native replacements are established. Consider animal pest control. Don't spray near waterways during whitebait / matamata / inanga spawning season (Feb-Apr).	Keep some cover for the shy birds. Slowly replace mature alders and willows by planting native trees and shrubs underneath.
Harvest kai such as eels, puha, honey.	Don't spray food plants like blackberry in harvest season, and use bright dyes with your herbicide to warn people what's been sprayed. Replace willows with suitable rongoa and kai species such as manuka and other honey plants. Plant fish spawning plants in tidal areas e.g. Carex, swamp millet low on the river bank.	As for rivers and streams
Provide shade/shelter for stock, soak up dairy effluent or stabilise hill slopes	Plant and manage fast-growing shelter trees in paddocks and non-invasive willow on steep gully slopes. If the bank is unfenced, run a temporary hot wire just inside the paddock edge of the willow until the paddock trees are big enough to provide shade, then fence the riparian margin permanently and slowly replace the river-side willows with natives.	Plant and manage fast-growing shelter trees in paddocks away from the wetland. If the wetland is unfenced, run a temporary hot wire just inside the paddock edge of the willow until the paddock trees are big enough to provide shade, then fence the wetland margin permanently and slowly replace the wetland willows with natives.
Restore water views or access for boating / fishing	With council permission, remove a few trees here and there where the banks are stable (e.g. inside bends) and plant with low-growing sedges. N.B. It may not be possible in all cases to restore a water view.	Remove manageable sections at a time to create 'windows' among the willows and plant with low native vegetation. Widen the gaps as time permits.
Maintain a green screen	Plant fast-growing native trees like cabbage trees and lowland ribbonwoods along the edge of the willows/alders, then slowly replace the willows and alders.	Plant fast-growing native trees like cabbage trees and lowland ribbonwoods along the edge of the willows/alders, then slowly replace the willows and alders with larger trees such as kahikatea, swamp maire, totara, rimu etc. for more height.





## What's your situation?

Follow the decision tree for tips specific to the type of site you are working in.



## 4. Using willows wisely

*If you want to plant or retain willows on your land, for whatever reason, you'll need to manage them.*

Most council river engineers in New Zealand agree that willows are the big guns – the best front-line defence when it comes to fixing badly slumping banks on rivers and wider streams. In these cases willows are used in two ways.

- 1) They are planted to keep existing river banks stable.
- 2) They are used in erosion control structures that repair river banks after they have eroded.

Unmanaged willows causing flooding and erosion. HR Photo: Waikato Regional Council



*"Willows are likely to remain the primary ... tool in flood protection and river control because their attributes combine to make them the most cost-effective biological solution to riverbank protection. However, the key to keeping willows beneficial rather than becoming a pest lies in continuing to use the right kinds of willows in the right places and a continual eye on maintenance." Chris Phillips & Christine Daly, Landcare Research report, 2008.*



Vegetation structures that use willows are far less expensive than hard engineering structures such as rock rip-rap or concrete or timber revetment (lining of riverbanks). If we don't plant them, banks erode, rivers get wider and we lose land. If we do plant them- but don't manage them- sediment gets trapped, roots grow out into the river, the river gets narrower and we get more local flooding. It's a fine balance to keep the river just so!

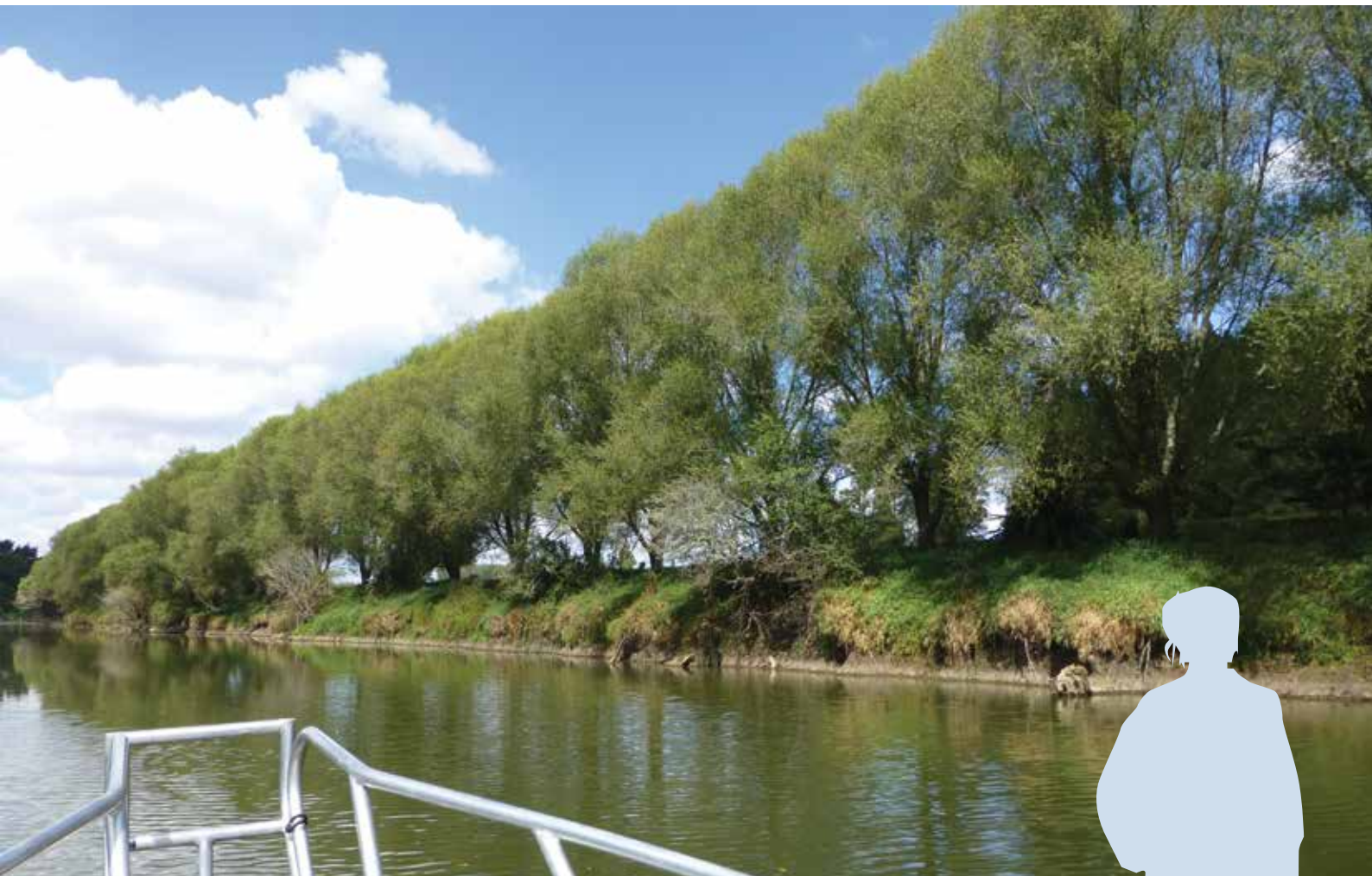
For a longer-term solution, native plants are being used more and more to provide a better variety of vegetation and habitat. They need to be planted at a sufficient distance back from the bank to support the mature tree through its life-time if stream bank erosion is to be controlled. Natives are being used mostly on smaller streams, leaving willows to do the hard work where water flows are fast.

It's important to use the right willows, like Matsudana, not crack or grey. They need to be planted back from the bank, a reasonable distance apart leaving space for longer-term native plantings at the stream edge and between the willows. They may need to be pruned and replaced after 10-20 years, as large, old trees can tip over and break away in a storm, float downstream and damage bridges, culverts or whitebait stands.

For more details, read the Waikato Regional Council guidelines on managing vegetation on river banks (see the 'Useful links' section).

If you want to learn more about managing willows for stock fodder see the Hawkes Bay Regional Council guide listed under the 'Useful links' section.

Matsudana willow trees lining an erosion prone river bank. Photo: Waikato Regional Council



*"If you want to replant a stream bank with natives but keep the banks stable, it is important to maintain a good cover of grasses on the bank edge. Planting too densely can shade out the native grasses and sedges on the very edge of the bank that often do the most to stabilise it" – Waikato Regional Council Best Practice for Streamside Vegetation Control, 2007.*



## 5. Control options

*If you've decided you need or want to remove willows or alders on your land, or in your restoration project, you'll need to know what to do.*

There are several options depending on your situation.

1. **Ground methods.** If you have a small area that's easy to reach, you can cut down, haul out, hand pull, use herbicide or stump cut and then spray regrowth the following year, to remove or kill trees, saplings or seedlings. Be aware though, if you're not going to use chemicals to remove willows, it will be a very slow process and be labour intensive. Pick project sites carefully and avoid badly eroding river banks unless council staff have already visited the site as part of the permitting process. See section 5 for ground-based herbicide control options.

2. **Aerial spraying.** If you have a large area of dense willow you want to get rid of, or scattered trees in hard-to-reach or sensitive wetland areas, aerial spraying with herbicide from a helicopter is really the only option. You may need a resource consent, so talk to your Regional and District Council.
3. **Under-planting.** If you are happy to wait for decades, and there's not a lot of valuable wetland area downstream or downwind, try under-planting dense willow or alder stands with shade-tolerant natives (see section 7). Combine with ground methods to stop the spread of seedlings and thin out the canopy to help the natives grow.
4. **Water level control.** Other options may be available, such as water level control (e.g. flooding a natural site or constructed pond for the few weeks when willow seeds are ripe so they can't settle and invade). Talk to the Regional Council for advice on that.

For a detailed guide on willow control, read the Australian Willows Management Guide (see 'Useful links' section).

*"Grey willows are the weed equivalent of managing possum in forests – you have to keep at it"*  
- James Griffiths, DOC

DOC wetland at Opuatia with willow sprayed (right) and unsprayed (left).



*"It would have taken four people a month to spray in a ground-based operation, and they would have been up to their shoulders in water"* - James Piddock, South Waikato District Council, on an 11 ha grey willow wetland that was sprayed by helicopter in half an hour.

## Which species?

**Grey willow** are the most invasive. Stop their spread into healthy wetlands by hand pulling seedlings and poisoning saplings (see section 6). Plant bare areas with dense native ground cover like purei sedges. Do any weed control from December on- well after the grey willow sets seed- as its seeds will take hold in any newly cleared areas. If using ground-based methods, focus on removing the female trees as a priority- flowers appear in early spring, male trees have yellow pollen-covered flowers, females have fluffy white ones. If you can't take them out right away, mark the females (e.g. with wooden marker or permanent paint) for later removal.

**Crack willow** will invade swamps and stream sides, but it only spreads by broken stems or branches in New Zealand. Remove them by working downstream, inter-plant with natives as you go, and focus on smaller streams with stable banks. On bigger rivers, target small plants that can be removed without damaging stream banks or losing wildlife values. In wetlands

you don't have to remove the crack willow if you are confident they are dead. It might be better to leave them standing dead if possible. It's less ground disturbance so less weed invasion, and provides roosting habitat for birds. The willows will naturally decay and decompose with time, but go back next spring to ensure they are dead, and remove those that could become a hazard.

**Non-invasive willow varieties** may perform an important role on stream banks or as stock fodder etc. Use them to replace problem willows in erosion-prone areas. Booth shrub willow needs rejuvenating (cutting back hard so it sends up new branches) or replacing every 15 to 20 years. Tree willows have a lifespan of 30 to 50 years but any tree that is threatening to fall over into the river should be removed before it does so.

**Alder** are still a bit of an unknown, try thinning and under-planting dense stands with shade-tolerant natives to replace them as they die out, and remove young or scattered trees.

Lake Mangahia willow control. Photos: Waikato Regional Council

Pre-aerial control, Nov 2008.



After aerial spraying, March 2011.



Planted natives have room to grow after willow control, Dec 2014.



*"Vegetation monitoring following a cut and paste operation at Lake Mangahia showed an initial light shock effect early on, but the natives bounced back within two seasons. Now basal bark spraying is used to reduce light shock by letting the tree slowly die standing up. In 2013 ground based control covered 4 ha, and took five people ten days. The lesson is there are many, many years of control - you can't spray and walk away." Paul Smith, Waikato Regional Council*



# 6. Control and disposal methods

*Willow and alder removal takes time and money. Don't waste either by cutting them down and walking away – they'll just grow right back. Except for plants small enough to hand pull, you will need to use herbicide to kill these trees, and keep an eye out for regrowth or seedlings.*

## Rules and Safety

You will need a GrowSafe certificate if you are using anything other than a low pressure back pack, and a Regional or District Council consent to use certain herbicides. Also make safety your number one priority – wetlands, chainsaws and chemicals make for a risky combination!

## Which herbicide

Only three types of herbicide that work on woody weeds can be used over or near water (and two of them will need a resource consent):

- **Glyphosate (e.g. Round-up)** – very effective, but kills every plant it touches (including natives), so is best used on dense, older willow or alder stands if spraying from the air. Consent is not required for ground-based use around waterways if you use the correct formulation, but might be needed for aerial application or to clear large areas.
- **Triclopyr triethylamine (e.g. Garlon 360)** – kills mainly broadleaf trees (willows and alders, but also native shrubs and trees), best for scattered willows or alders where most of the natives are monocots (strappy-leaved plants like flax, cabbage tree, sedges and native grasses), ideal if spraying from the air on young invading grey willow. Requires a resource consent from the Regional Council to use around waterways.
- **Metsulfuron - methyl (e.g. Escort)** – as for triclopyr triethylamine. Also requires a resource consent.

Other herbicides like Vigilant or Grazon can't be used around water as they can harm fish and other aquatic life, but may be ok in dry sites or times of year. Waikato Regional Council has some good information on herbicides and their application in their Guide to controlling weeds in riparian margins (see 'Useful links' section).

Waikato Raupatu River Trust and NIWA scientists working with local community and marae members from Te Puuaha o Waikato to remove willows and other weeds from the Mangati Whitebait restoration site. Photo: Waikato Raupatu River Trust



*"Ground-based application of Garlon® 360 as a spot spray provided more selectivity of control, and although some local damage to Carex secta was noted two months after spraying during the spot-spraying trial, ...*

## How to apply it

See the table on the next page for options.

Make sure you get these right (follow the instructions on the label):

- herbicide concentration
- timing
- application rate
- droplet size
- spray application pattern
- additives (e.g. penetrant)

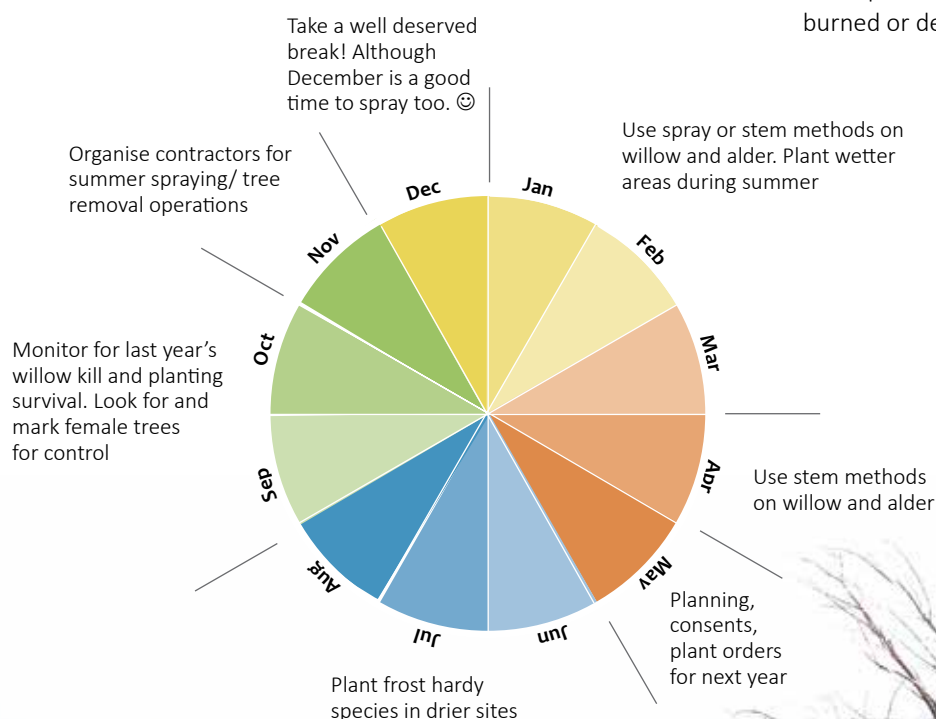
## When to apply it

Apply spray-on herbicide during summer to early autumn when the trees are in full leaf. Don't spray in windy conditions or when rain is expected. Stem injection or cut and paint methods can be done most times of year, but may be less effective in winter. Wait until about a month after grey willow has produced seeds before cutting down or spraying trees, so this year's seeds won't immediately invade the spot.

## What to do with the dead trees

If you don't treat willows and alders properly with herbicide, any cut stems and stumps will take root or re-sprout. Go back next spring or summer to check trees that have been sprayed.

- Any live ones will need to be re-treated.
- Dead ones can be left standing to provide habitat, weed suppression and bank stability – but cut down any near tracks, buildings or within 500 m of a downstream bridge or culvert to minimise risk of damage.
- Mulching live willow is not a good idea unless done, and used, well away from water, e.g. a feed pad or stand-off pad, so fragments won't resprout.
- Dried alder logs can be used for furniture or firewood.
- Unsprayed willows can be fed to stock to strip leaves, then pile and burn the rest.
- Hand-pulled seedlings can be sent to landfill or burned or deeply buried on a dry site.



*... this species fully recovered and had significantly expanded in area one year after the herbicide was applied.”*  
– Champion et al., 2011



## Ground-based willow and alder control options using herbicide

This table will help you choose the best method for your situation, see the links on page 17 for more details on your preferred method

Option	1. LEAVES Foliar spray- spray the leaves	2. TRUNK/STEM Drill and inject, frill, scrape and paste - drill or cut holes in the trunk and inject or paste on herbicide Basal spray – spray herbicide in oil or diesel onto the base of thin trunks	3. STUMP Cut and paste - cut down the tree and coat stump and trunk ends with herbicide
Best for	<ul style="list-style-type: none"> <li>Short trees (so you can reach the foliage), including regrowth from cut stumps</li> <li>Where there are no valuable species nearby</li> </ul>	<ul style="list-style-type: none"> <li>Tall trees with thick stems over 5 cm diameter (for drill and inject)</li> <li>Trees/ stems with thin bark under 20 cm diameter (basal spray)</li> <li>Where there is native understory/ valued native plants nearby</li> <li>Scattered trees with easy access</li> </ul>	<ul style="list-style-type: none"> <li>Any size – from large trees to regrowth shoots</li> <li>Where there aren't valued natives underneath</li> <li>Scattered trees with easy access</li> <li>Experienced chainsaw operators (for larger trees)</li> <li>Grey willow and alder, as missed fragments are least likely to resprout</li> </ul>
Pros and cons	<ul style="list-style-type: none"> <li>✓ Retains habitat for wildlife until the native vegetation has grown</li> <li>✓ Easy to apply from knapsack</li> <li>✗ Highest risk to native plants</li> <li>✗ Uses more herbicide than other methods</li> </ul>	<ul style="list-style-type: none"> <li>✓ Lowest risk to other plants (some risk to nearby trees with intertwined roots)</li> <li>✓ Leaves habitat for wildlife until the native trees have grown</li> <li>✗ Every single stem must be treated</li> <li>✗ Safety risk (drill or chisel safest)</li> <li>✗ Risk of herbicide spill (especially frill method)</li> <li>✗ Risk of herbicide moving through roots and soil into neighbouring plants</li> </ul>	<ul style="list-style-type: none"> <li>✓ Low risk to other plants (other than crushing)</li> <li>✓ Uses least amount of herbicide</li> <li>✗ Immediate loss of shade and roost sites</li> <li>✗ Falling trees may crush native plants</li> <li>✗ Untreated cut fragments may take root in damp areas</li> <li>✗ Safety risk (if working on large trees)</li> </ul>
Gear needed	<ol style="list-style-type: none"> <li>Knapsack</li> <li>Marker dye</li> <li>Herbicide and correct additives e.g. spreader, sticker, penetrant (refer to the label)</li> </ol>	<ol style="list-style-type: none"> <li>Cordless drill and 15 mm drill bit OR axe/hatchet OR chisel and mallet</li> <li>Drenching gun OR syringe set to 10 ml dosage (for drill method)</li> <li>Herbicide as liquid or gel and label-recommended additives (some basal spray herbicides come pre-mixed)</li> <li>Dazzle spray paint</li> </ol>	<ol style="list-style-type: none"> <li>Chainsaw/brush cutter, folding hand saw, loppers, or secateurs – depends on stem size</li> <li>Marker dye or coloured herbicide</li> <li>Herbicide as liquid with spreader/ penetrant, or gel</li> </ol>

Example of cut and paste. Photo: Waikato Regional Council.



Example of frilling. Photo: Waikato Regional Council.



Example of drill and inject. Photo: Kerry Bodmin



## Ground-based willow and alder control options using herbicide continued...

<b>General method</b>	<p>Ground-based spraying</p> <ol style="list-style-type: none"> <li>1. Mix up herbicide with marker dye according to the herbicide label. Can add penetrant/spreader if desired. (see note)</li> <li>2. Spray leaves on a calm, dry day, fully cover the foliage.</li> <li>3. Leave trees to die and rot.</li> <li>4. Check next spring/ summer for survivors, re-treat if necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Work in pairs – one to drill or cut, one to inject/apply the herbicide.</li> <li>2. If <b>drilling</b>- make a ring of holes every 5-10 cm around the tree near the ground, drilling at a 45 degree angle into the sapwood (light coloured outer wood). Squirt 10 ml undiluted liquid herbicide into every hole within 30 seconds</li> <li>3. If <b>frilling</b> – cut a series of cuts in the bark (or one all the way round) with an axe or chisel to expose the sapwood. Pour liquid herbicide just above so it runs into the cut, or squirt gel into the cuts</li> <li>4. If <b>spraying bark</b> – set sprayer to low pressure (20-40 psi or 1-2 pumps) and gently spray suitable herbicide all around the lower 20-40 cm and root collar of dry stems until they are wet but not dripping</li> <li>5. If <b>scraping</b> - use a chisel or knife to slice off a strip of bark about 30 cm long and squeeze herbicide gel all along the cut.</li> <li>6. Spray a ring of dazzle paint around the tree so you know which you have done</li> <li>7. Leave trees to die and rot</li> <li>8. Check next spring/summer for survivors, re-treat if necessary</li> </ol>	<ol style="list-style-type: none"> <li>1. Cut down the tree, or lop off shoots at ground level</li> <li>2. Immediately coat the sapwood part of the cut stump and stem (within 30 seconds) with herbicide gel or liquid.</li> <li>3. Poison the offcuts too, or haul away and burn them – untreated bits left behind can take root where they fall</li> <li>4. Leave stump to rot down</li> <li>5. Check next spring/summer for regrowth and re-treat (e.g. foliar spray) if necessary</li> </ol>
<b>Notes</b>	<p>Penetrants cut through the protective coating on the leaf allowing the herbicide to get into the leaf and be transported around the whole plant more effectively.</p> <p>Spreader enable a thin film of liquid to be deposited on a leaf, rather than whole droplets which may simply run off the leaf.</p> <p>Stickers are the additive that make the herbicide stick to the leaf.</p> <p>Only apply to clean, dry leaves (not muddy/ silt covered ones).</p>	<p><b>If using a drenching gun, label it with poison and keep away from stock drenching gear!</b></p> <p>Don't get mud on the drill bit/axe</p> <p>Chisel and squirt bottle is the better option for volunteers</p>	<p><b>If using Vigilant gel ensure no drops are allowed to reach the ground or water</b></p> <p>Only the light coloured outer wood (sapwood) needs to be coated with herbicide.</p> <p>It is an offence to leave a significant quantity of timber within the flood zone which may cause a navigation hazard or risk to downstream structures and users in the event of flooding.</p>

For short videos showing these methods, search for "Australian National Willows Taskforce DVD" on YouTube.

See also Waiholā-Waipori Operational Plan link on following page.

Otago Conservancy tips for basal spraying on the Waikato Biodiversity Forum website Features page  
[www.waikatobiodiversity.org.nz/about\\_us/features/third\\_feature/](http://www.waikatobiodiversity.org.nz/about_us/features/third_feature/)



## *Examples of successful herbicide use by volunteer groups and councils in New Zealand*

See how Otago, Waiholo-Waipori volunteers control woody weeds in their wetland <http://waihola-waipori-wetlands.org.nz/about/weed-control-advice/> and read their detailed Weed Control Operational Plan: <http://spiralis123.files.wordpress.com/2011/01/weed-control-operational-plan-final-adopted-plan-january-2010.pdf>.

The former Waitakere City Council in Auckland successfully used 10 g Escort + 1 litre Roundup, 20 ml Pulse penetrant, and 1 ml Landmark Dye in 2 litres of water for willow stem treatment options.

See their Willow Best Practice Guidelines at [www.waitakere.govt.nz/cnlser/pw/greennetwk/pdf/willow-control-best-practice.pdf](http://www.waitakere.govt.nz/cnlser/pw/greennetwk/pdf/willow-control-best-practice.pdf). This contains some great photopoint images.

The council also trialled aerial spraying of willow at Te Henga wetland in West Auckland. Read about the trial outcomes in this report: [www.waitakere.govt.nz/cnlser/pw/greennetwk/pdf/tehenga-willow-control-report.pdf](http://www.waitakere.govt.nz/cnlser/pw/greennetwk/pdf/tehenga-willow-control-report.pdf).

Grey willow island, Te Henga wetland. Photo: Auckland Council



*“When spraying willows or alders in the wetland, it is best to wait until low water conditions before doing any spraying. This will ensure that the minimum number of small branches and leaves will remain protected from the spray by being under water. If the trees are sprayed when the water levels are too high then a poor kill may be achieved, with the trees re-sprouting from their bases.”* Lake Waiholo-Waipori Wetlands Society website.

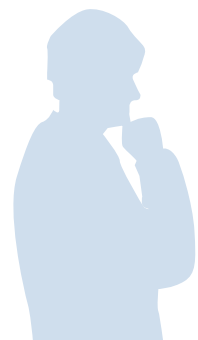
## 7. Planting options

*Whichever option you choose for controlling willows and alders, taking out unwanted exotics is only half the job. Unless you fill the gap with wanted plants you might just get other weeds coming in – or willows and alders coming right back!*

Thick shade is probably the only way to stop willows and alders coming back – so if you want to **restore biodiversity**, plant damp or swampy areas densely with suitable natives, including ground-covering sedges and tall species like manuka, kahikatea, cabbage trees, swamp maire, pukatea, putaputaweta, and pokaka.

- Removing **dense canopy willows and alders** may create the perfect conditions for light-loving weeds, including more willows and alders to re-invade. A staged approach is probably best for dense infestations, taking out sections of the exotic trees at a time, replanting with natives and watching for weeds until the natives are dense enough to shade most of them out (5-10 or so years). Work downstream and downwind to reduce re-invasion risk.
- **In very weedy areas**, willows and alders may be the least of your worries. Carpets of smothering plants like tradescantia, yellow flag iris and reed sweetgrass can stop any native understory from developing. You may be better off focussing on those weeds initially (working from the outer edge of the weed patch inwards, and from upstream to downstream). Plant shade-tolerant natives under the canopy. Once they've taken hold and the understory weeds are gone, you can poison and remove the willow and alder.
- Where there is already a **good native understory**, it may just be a matter of planting some shade tolerant future canopy trees like pukatea, and waiting for the exotics to die out – be patient, it may take 60-100 years!
- In **patchy, open water areas**, or where you want to keep low native plants like sedges and flax, you'll probably have to keep on managing willows as they pop up.
- **Peat bogs** have special planting needs – seek advice on restoring them from the Regional Council or DOC.
- If your site has **serious bank erosion problems**, carefully selected willow species or cultivars that won't become pests will be the best option for a quick result. Interplant them with a good variety of natives- some shallow rooted, some deep rooted, smaller species closer to the water. Be aware that willows of some sort may be required over the long term to retain stability. It's best to seek advice from Waikato Regional Council on where this is appropriate and what type of willow plants to use.

See the 'Useful links' section for planting guides for riparian and other situations.



*"... considerable care must be taken to assemble a native plant community consisting of species having a wide range of strategies. In a natural setting this will include tall trees, shade tolerant understorey, effective dispersing and quick growing colonisers, scramblers, climbers and lianas as well as epiphytes and ground covers. Each species contributes to the matrix and collectively they will out-compete willows but this will take time, successive planting and require maintenance in the interim." Wayne Bennett, Forest Flora*



# 8. Useful links

This guide is an overview to help you decide what to do about willows and alders on your land. Here are links to more detailed guidelines on managing or removing these species. These links are current at the time of publication, but may change as websites are updated.

## 1. Planting guides for the Waikato

For a good introduction, start with the Waikato Regional Councils guide to **Planting natives in the Waikato Region**

[www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Planting-guides/#heading4](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Planting-guides/#heading4)

DOC planting guides for Waikato River and Hamilton Basin

[www.doc.govt.nz/getting-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/](http://www.doc.govt.nz/getting-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/)

Waikato River Care guidelines

[www.waikatorivercare.co.nz/Cache/Pictures/2354411/WRC\\_Best\\_Practise\\_Booklet\\_31March\\_DIGI.pdf](http://www.waikatorivercare.co.nz/Cache/Pictures/2354411/WRC_Best_Practise_Booklet_31March_DIGI.pdf)

Dairy NZ riparian guidelines

[www.dairynz.co.nz/publications/environment/getting-riparian-planting-right-in-the-waikato/](http://www.dairynz.co.nz/publications/environment/getting-riparian-planting-right-in-the-waikato/)

Riparian planting wheel

[www.landcare.org.nz/News-Features/News/Plant-Selection-Wheel](http://www.landcare.org.nz/News-Features/News/Plant-Selection-Wheel)

Wetland factsheets

[www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Wetland-planting-guide/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Wetland-planting-guide/)

Kahikatea forests factsheets

[www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Forest-fragments/Kahikatea-forest-fragments/Kahikatea-forest-fragment-planting-guide/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Forest-fragments/Kahikatea-forest-fragments/Kahikatea-forest-fragment-planting-guide/)

Lake margins

[www.doc.govt.nz/getting-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/](http://www.doc.govt.nz/getting-involved/run-a-project/restoration-advice/native-plant-restoration/local-planting-guides/ecological-restoration-in-the-waikato/)

Stream gullies

[www.gullyguide.co.nz/index.asp?pageID=2145821537](http://www.gullyguide.co.nz/index.asp?pageID=2145821537)

Bee food

[www.treesforbeesnz.org/farms/regional-brochures-north](http://www.treesforbeesnz.org/farms/regional-brochures-north)

## 2. Management and planning tools/templates

Create a management map

[www.landcare.org.nz/wetmak](http://www.landcare.org.nz/wetmak)

Ake ake planning tool – use past and current knowledge to develop a vision for the future

[www.sciencelearn.org.nz/Contexts/Toku-Awa-Koiora/Sci-Media/Video/The-Ake-Ake-model](http://www.sciencelearn.org.nz/Contexts/Toku-Awa-Koiora/Sci-Media/Video/The-Ake-Ake-model)

Wetlands management plan template

[www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Create-your-own-wetland-plan/](http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Create-your-own-wetland-plan/)

River bank planning steps

[www.waikatorivercare.co.nz/Cache/Pictures/2354411/WRC\\_Best\\_Practise\\_Booklet\\_31March\\_DIGI.pdf](http://www.waikatorivercare.co.nz/Cache/Pictures/2354411/WRC_Best_Practise_Booklet_31March_DIGI.pdf)

Planting budget tool

[www.dunestrust.org.nz/resources/planting-calculator/](http://www.dunestrust.org.nz/resources/planting-calculator/)

For an idea of costs for stream-bank restoration options see Appendix 11 of the Waikato River Scoping Study

<http://202.36.137.86/sites/default/files/appendix-11-riparianaesthetics.pdf>

### 3. Willow management

To learn how to identify willow species and tell the difference between male and female trees, see

[www.weeds.org.au/WoNS/willows/docs/Willow\\_identification-Resource\\_Sheet2.pdf](http://www.weeds.org.au/WoNS/willows/docs/Willow_identification-Resource_Sheet2.pdf)

For a good introduction to willow biology, seed production etc.

[www.hoadley.net/cremer/willows/docs/WillowInBiodiversity.pdf](http://www.hoadley.net/cremer/willows/docs/WillowInBiodiversity.pdf)

Australian Willows Management Guide

[www.weeds.org.au/WoNS/willows/docs/Willows\\_fore\\_pages.pdf](http://www.weeds.org.au/WoNS/willows/docs/Willows_fore_pages.pdf)

Detailed guidelines on managing vegetation on Waikato river banks

[www.waikatoregion.govt.nz/PageFiles/5677/tr0741.pdf](http://www.waikatoregion.govt.nz/PageFiles/5677/tr0741.pdf)

General guide to growing or managing willows (and poplars) on farms

[www.fao.org/forestry/21644-03ae5c141473930a1cf4b566f59b3255f.pdf](http://www.fao.org/forestry/21644-03ae5c141473930a1cf4b566f59b3255f.pdf)

The “Weed Control Operational Plan for the Waihola-Waipori Wetland System” has some very detailed instructions on dealing with willows and alder and is a good model for a detailed weed operation plan:

<http://spiralis123.files.wordpress.com/2011/01/weed-control-operational-plan-final-adopted-plan-january-2010.pdf>

Waikato Regional Council’s Controlling weeds in riparian margins guide

[www.waikatoregion.govt.nz/PageFiles/3599/weeds%20and%20Riparian%20margins.pdf](http://www.waikatoregion.govt.nz/PageFiles/3599/weeds%20and%20Riparian%20margins.pdf)

The rules around using herbicides around waterways are in this handy guide from the EPA

[www.epa.govt.nz/Publications/Using-herbicides-to-control-aquatic-pest-plants.pdf](http://www.epa.govt.nz/Publications/Using-herbicides-to-control-aquatic-pest-plants.pdf)

NZ Cawthron Institute Effects of willow removal on Australian and New Zealand stream ecosystems

[www.cawthron.org.nz/publication/science-reports/effects-willow-removal-australian-and-new-zealand-stream-ecosystems/](http://www.cawthron.org.nz/publication/science-reports/effects-willow-removal-australian-and-new-zealand-stream-ecosystems/)





