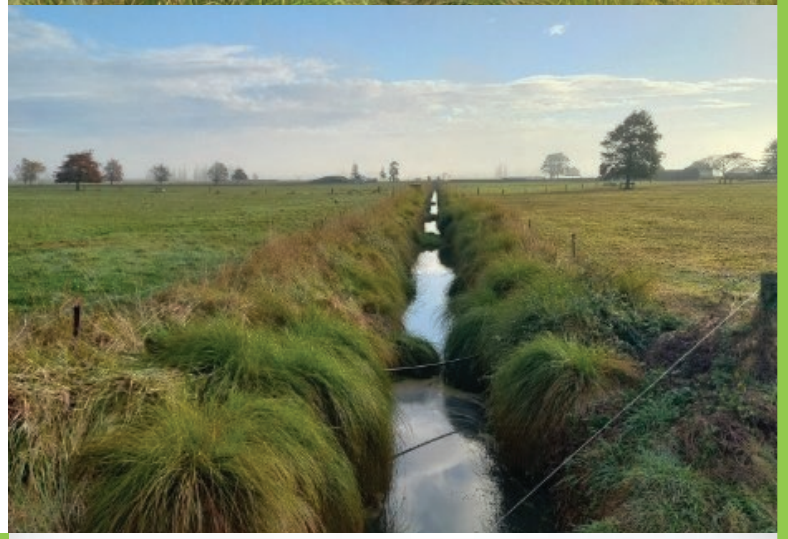
GUIDE

CAREX PLANTINGS ALONG BOARD DRAINS 'Sedges on Edges'

Waikato Regional Council
Te Kaunihera ā Rohe o Waikato

Piako Waihou Catchment Trust

NZ Landcare Trust
Ngā Matapopore Whenua



Carex plantings along Board drains Guide

Waikato Regional Council (WRC) have been undertaking small scale drain planting trials for a number of years. The aim of these trials is to develop a tool for drainage management that reduces maintenance costs and/or effort and improves the environmental performance of land drainage networks through improvements in water quality and by providing habitat.

Monitoring of these sites and review of information from others doing similar work has shown great results in reducing the frequency of weed sprayings and/or mechanical excavation and improved water quality through less disturbance, cooler water temperatures and higher dissolved oxygen concentrations. Improved outcomes for fish life are apparent from field observations, but harder to show due to the small scale of these trial sites. Bird life benefits from having streamside vegetation in which to forage and breed.

Native sedges (*Carex*) were the key plants used as they:

- Bind the banks together and prevent sediment from entering water.
- Provide shading of the water to suppress nuisance aquatic weeds growth, reduce water temperatures and increase dissolved oxygen concentrations.
- Incorporate nutrients into their leaves and roots systems preventing those nutrients from entering water and causing algal blooms and excessive aquatic weed growth.
- Grow low and don't impede access to the drain for any necessary maintenance.
- Grow quickly so that these benefits are rapidly achieved.
- Are cost effective and easily maintained through the use of selective herbicides.

In order to further develop the method at scale and to be able to gain more definitive results from a focused scientific monitoring programme, the next phase has been carry out the approach on a much larger scale trial site than has been used previously.

This started in 2022 where 4km of drain was planted on both sides with *Carex* sedges (see Table 1, below) with occasional cabbage trees to provide additional shade. The expected reduction in maintenance requirements, sediment deposition and improvements in water quality, habitat and fish life is being monitored and compared against a similar, unplanted drain in the same catchment. See map of control and treatment channels in map, top-right.

Location of trial to the west of Morrinsville.

Existing Tauwhare trial site 15 years after being planted in native *carex* species, 2020.
Photo: Waikato Regional Council

Table 1: The three amigos (the three main *Carex* species that we've used).

Scientific name	Common name	Description	Conditions it likes	Picture[1]
Carex secta	Purei, makura	1–1.5m tall. Drooping harsh tussocks forming trunk like base when mature. Green year-round.	Moist lower embankments and shallow water to 0.2 m depth.	
*Carex geminata**	Rautahi, cutty grass	0.5-1.2m tall. Spreads from rhizomes (roots), flat leaves that have a sharp edge.	Freshwater wetlands, along river and stream banks, lake margins, and in damp seepages, pond margins and clearings within forest.	
Carex virgata	Pukio	Very similar to *C. secta* but more upright and can handle drier conditions. 1–1.5 m tall. Green year-round.	Freshwater wetlands, along river and stream banks, lake margins, and in damp seepages, pond margins and clearings within forest.	

N.B. While not used in this trial, Giant Umbrella Sedge (*Cyperus ustulatus*) is also a very good plant for this kind of approach.

* *Carex geminata* for south Waikato and *Carex lessonia* for north Waikato

THINGS TO CONSIDER *if you are thinking of doing this yourself*

1. What do you want to achieve?

Low cost, maintenance free, improved water quality/ecological and/or, biodiversity outcomes? All can be achieved, but depending on the outcome you want you'll need to apply different approaches for each outcome, along with associated differences in cost, maintenance etc.

Carex plants are easily obtained, tough, low growing and inexpensive. Other options are a mix of *Carex* species but with some additional plant types to add more diversity, through to full riparian planting on one side of the drain channel in order to maintain access (see the photos on following page).

It's important to check with your local Council (District and Regional) whether there are any restrictions around planting drains or waterways that they have responsibilities to maintain i.e., land drainage schemes. One of the advantages of this method is that access to the channel is maintained if needed.

2. Site preparation

Fences ideally will be at least one metre back from the water, depending on how the waterway is classified. You don't need too much room for a row or two of *Carexes*, but if you want to make the planted strip wider, consider fencing 3 – 5 metres back from the water.

The ideal situation is that all weeds are well contained at the site and that pasture grasses are the only plants present. You can spot spray prior to planting – it aids in the initial establishment of the *Carexes* and makes digging easier. Don't spray the whole drain bank because it could lead to bank instability.

[1] Images in table sourced from New Zealand Plant Conservation Network (nzpcn.org.nz)

3. When do I want to plant?

Aim to plant between May and September, depending on the soil moisture. In drought-prone areas, earlier is generally better so roots can establish deep enough in the soil before the seasons change and warm, dry conditions set in.

Aim to plant both sides of the watercourse at the same time. This has the advantage of ease of maintenance, but consider staging your planting if you haven't done this type of planting before. Plant sections that you can manage, you don't want to bite off more than you can chew.

4. How do I plant?

Space out your *Carex* according to their requirements (see Table 1, above), giving them space to grow.

Dig a hole twice the size of the plant container and soften up the soil in the bottom of the hole. Remove the plant from the container and set in the hole. If a post hole borer is use, roughen up the sides of the hole to allow the roots to penetrate. Fill in the soil around it, compacting down to remove any air gaps. Ensure the plant is firmly planted in.

5. Planting spacing

You have a choice here. You could plant at 0.5m spacing, so you are planting more densely at the beginning which will allow canopy closure earlier on and will help reduce maintenance costs by suppressing weeds. Or, you initially plant further apart (0.5 – 1.0m), which will require more maintenance, and costs will be higher as canopy closure will take longer. Planting spacing also depends on species selection. For example, *C. geminata* will spread over time from their roots, so can initially be planted further apart.

6. Costs

Costs – the indicative costs (in Table 2, below), are those used for the WRC trial. They are worst case i.e., if you are buying large plants (0.5 litre pots) and paying a contractor to do all of the work of planting and releasing. There are a number of options to reduce these costs by doing the physical work yourself and/or buying a smaller grade of plant.

A section of trial drain before planting, Fences stayed where they were. 2022. Photo: WRC

TOP TIP

DairyNZ **riparian planner** is a great tool for mapping, planning and budgeting.

WRC staff can also provide maps and advice.

TOP TIP

If planting a large number of plants, **consider using a post hole borer** to help speed up planting, although be careful not to go too deep.

Using a post hole borer to pre-drill holes. Photo: Jude Tisdall

Table 2: Indicative costs have been included.

Number of plants required @1m spacings for 1 km (both sides planted).	Plant purchase, delivery and planting: $6.00 per plant - based on a contractor doing all of the work.	Site prep – one spot spray per plant. 50c - $1. Based on a contractor doing the work.	Maintenance (two releases – one in early summer and one in autumn). May need more for ongoing maintenance. 0.50c - $1 per plant. Based on a contractor doing the work	Total per 1km	Total $ per 100m (both sides)
2,000	**$12,000**	**$500 - $1000**	**$1000 - $2000**	**$13,500 - $15,000**	**$1,350 - $1,500**

7. Maintenance

Because the three species of *Carex* used – *secta, virgata* and *geminata* are all sedges, you can use selective herbicides which contain Haloxyfop. These will kill paspalum and pasture grasses which may compete with the young sedge plants until they are established. Also, because *Carex* are types of plants known as monocots, you can also use broadleaf (dicot) specific pasture sprays to control other competing weeds such as bind weed and privet. Sprays containing 2.4.D or Triclopyr are examples of dicot specific chemicals. You should always follow the label recommendation when using chemical herbicides and check if you can spray over water.

Living Waters/University of Canterbury CAREX Silverstream restoration trial [2]

General management approaches include site prep and maintenance

Get your site as clean as you can before planting. The ideal is that prior to planting, the site is dominated by rank grasses with as little woody weeds as possible. This will simplify any maintenance that is required after planting.

Consider if you need to move fences. A single row of *Carex* sedges will grow to 1-1.5m wide, so for best results and maximum shading of the channel are best suited for drains one metre to two metres across. Cows will eat the edges of the *Carex* along the fence line to keep the fence clear and the *Carex* can withstand light grazing.

Spray as required to control weeds, but generally a spray is required the first spring after planting, followed by a summer spray. If the plants were in early enough and it's been a good season, they should be big enough to look after themselves in their second year.

Alternatively, you could carry out more comprehensive planting on one side with trees and shrubs, so that maximum shading benefit is provided, but access for maintenance is maintained on the other side, such as in the photo to the right.

TOP TIP

If you have a dog-leg bend in the drain, plant a cabbage tree or two in the corner. This is also really useful if the drain runs in a north-south direction – plant a taller plant (e.g., cabbage or manuka/kanuka) every 10 or so metres to provide extra shading that won't restrict access for maintenance.

[2] https://www.livingwater.net.nz/case-studies-and-resources/case-studies-4/silverstream-project-university-of-canterbury/

FURTHER RESOURCES AND STUDIES

Waikato Regional Council have produced the following wetland factsheets:

Wetland rehabilitation

Wetland planting guide

Wetland wildlife

Information and contacts

The Canterbury Waterway Rehabilitation Experiment (CAREX), tests practical tools to address aquatic weed, sediment and nutrient management issues in lowland Canterbury, and to improve agricultural waterway health. More information **here**.

DairyNZ has made a short **video** (4:36 mins) on "three steps to help make your riparian planting a success". Aimed more at a mixed native riparian planting, there are some useful tips.

Typical farm drain on Waiorongomai Valley Farm 2021. Photo: Johan van Ras

Same drain planted, 2021. Photo: Nardene Berry

Example: Waiorongomai Valley Farm Ltd

A typical farm drain has water exposed to light which promotes weed growth and the retention of water. These weeds need to be sprayed yearly which exposes banks and tends to make them wider over time.

To make things as easy as possible, and achievable cost wise, a 400m long strip on both sides of this drain was planted in September 2021 with native plants, 0.5m apart. Used *C. geminata*, *C. secta*, and Giant umbrella sedge, with flaxes and cabbage trees further away from the water, closer to the fence.

Cost $4,500 to do just one strip. Left the rest for digger access.

It will be a year in September 2022, and the plants are growing so well, it's looking great.

Same drain planted, 2022. Photo: Johan van Ras

Because *Carex* species are monocots, you can use selective herbicides for broadleaf weeds as well as paspalum and pasture grasses to allow the native *Carexes* get established and for any weeds that pop up. This can keep your costs down initially, with the cost of spray being spread over time and incorporated into farm management.

Table 3: Recommended herbicide for weedy plants.

Target plants to be controlled	Recommended herbicide*	Notes on use
General weed control	Glyphosate (e.g., Roundup®)	Non-selective, it will kill most plants. Careful spot application required to avoid impacts on wetland plantings. Generally low toxicity and non-residual, broken down rapidly. Only use formulations recommended for use over water e.g., Roundup Renew, Agpro Green Glyphosate. Also useful for cut stem/stump treatment of woody weeds (e.g., grey willow).
Selective control of grasses	Haloxyfop** (e.g., Gallant®)	Generally kills grasses only. Minimal damage to other monocots (sedges, cabbage trees, flax, rushes, etc.), but minimise overspray. Does not kill broadleaf plants, ferns, etc. Foliar active with minimal soil activity, moderately low toxicity, short soil residue.
Selective control of woody broadleaf plants (e.g., blackberry and willow)	Triclopyr triethylamine (e.g., Garlon® 360)	Kills many broadleaf species including shrubs, vines and trees. Does not kill grasses, but may cause limited damage to sedges, flax or other monocots or ferns. Moderately low toxicity, short soil residue. Also useful for cut stem/stump treatment.
	Metsulfuronmethyl** (e.g., Escort®)	Kills most broadleaf species including ferns, shrubs, vines and trees except *Solanum* species. Generally not effective on grasses or other monocots (e.g., sedges and flax) unless applied at very high rates. Moderately low toxicity, however, short but very active residue, apply with extreme care, works at very low rates. Also useful for cut stem/stump treatment.

The New Zealand Novachem Agrichemical Manual provides detailed information on use of all registered herbicides. Use all herbicides carefully according to label recommendations and avoid overspray of non-target plants.

*Mention of specific herbicides does not constitute specific endorsement, nor mean that other products with equivalent active ingredients will not provide similar results.

**Herbicides not specifically registered for use in waterways, but they can be used by regional and central government agencies under a Permission from the New Zealand Environmental Protection Authority (EPA). Therefore, they should only be used in situations that avoid contamination of waterways. There are no EPA controls over the use of glyphosate where contamination of waterways may occur. However, check with your local regional council as you may require specific resource consent (under the Resource Management Act) for use around and in waterways.

PLANT SELECTION: Key species for wet margins and embankments

These species are suitable for planting in wet margins and on dry embankment slopes to reduce bank erosion and weed ingression and enhance plant and habitat diversity. For identification of these species, see 'Wetland Plants in New Zealand' (Johnson and Brooke, 1989).

Table 4: Key native plant species for wet margins and embankments.

Plant species	Common name	Natural range	Description	Planting position	Comments	Picture
Bolboschoenus fluviatillis and B. medianus	Purua grass, kukuraho, ririwaka, river bulrush, marsh clubrush	Northland to Westland and Canterbury	1–1.8 m tall. Leafy sedges with stems, (triangular in cross-section), emerging from woody, bulbous tubers	Shallow water to 0.3 m depth.	Common in coastal areas. Fast-growing in spring and early summer, dies back over winter. Provides seasonal diversity	
Carex secta	Purei, makura	Throughout New Zealand	1–1.5 m tall. Drooping harsh tussocks forming trunklike base when mature. Green year-round.	Moist lower embankments and shallow water to 0.2 m depth.	Establish initially in moist conditions or shallow water, can grow in deeper water if gradually acclimatised. Classic New Zealand plant of wetland and stream margins.	
Other Carex spp.; especially C. germinata, C. lessoniana and C. virgata	Rautahi, carex	Throughout New Zealand	0.5–1.5 m tall. Harsh leafy sedges. Green year-round.	Moist lower embankments and shallow water to 0.2 m depth.	Taller-growing species mentioned are likely to be the most robust and able to compete with weeds. Valuable for wildlife.	
Cortadera richardii, C. fulvida, C. toetoe	Toetoe (New Zealand native species only, not to be confused with introduced pampas grasses)	Different species common in different regions	1.5–3 m tall. Coarse green tussocks, with tall feathery flower heads borne on cylindrical stems.	Upper & lower embankments to water edge and surrounds.	Useful, hardy plant suitable for bank stabilisation and screening. Ensure invasive introduced pampas species are avoided.	
Cordyline australis	Ti kouka, cabbage tree	Throughout New Zealand	Tall-growing soft-stemmed tree bearing tufts of fibrous leaves.	Tall-growing soft-stemmed tree bearing tufts of fibrous leaves.	Classic New Zealand tree common in wet soils.	

[1] Images in table sourced from New Zealand Plant Conservation Network (nzpcn.org.nz)

Plant species	Common name	Natural range	Description	Planting position	Comments	Picture
Cyperus ustulatus	Toetoe upokotangata, giant umbrella sedge	Northland to Canterbury and Fjordland; mainly coastal and lowland	0.5–1 m tall. Harsh pale-green leaves in clumps, with emergent seed-bearing leafy umbells.	Moist lower embankments and shallow water to 0.2 m depth.	Tolerates dry periods. Suitable for wetland margins and embankments, and shallow water.	
Phormium tenax	Harakeke, New Zealand flax	Throughout New Zealand	1–3 m tall. Robust clumps of tough robust leaves. Tall dark brown to black flower heads.	Upper & lower embankments to water edge and surrounds. Potential to be pulled out during flooding if banks are steep which can cause further erosion. So keep further back from flooded areas.	Does not generally establish well in continuously flooded conditions. An important traditional plant for Māori and important habitat for wildlife.	

Above: Before planting of a watercourse through Golden Farms which flows into the Mangakotukutuku stream, Hamilton in 2014. Photo: Mangakotukutuku Stream Care Group

Above: Same watercourse on Golden Farms after planting in 2017. Photo: Mangakotukutuku Stream Care Group

Above: Drain planting trial site, Hauraki Plains, 2020. Photo: WRC

THANKS TO:

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