

**RIPARIAN
RESTORATION GUIDELINES**

DRAFT

Twin Streams Project

Lower Oratia Catchment

WAITAKERE CITY

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1.0 INTRODUCTION

The main requirements for riparian restoration in the Lower Oratia catchment are to;

- ◆ Restore riparian biodiversity.
- ◆ Restore ecosystem functioning.
- ◆ Maximise ecosystem services provided by riparian and instream habitat.

This includes;

- ◆ Eradicating existing invasive weeds.
- ◆ Revegetating bare areas with nurse species or interplant canopy species where an existing nurse cover occurs.
- ◆ Using eco-sourced plants locally endemic to the Waitakere area.
- ◆ Regular maintenance to control invasive weeds.

Replacing exotic weeds with native vegetation will act to improve habitat quality by increasing vegetation diversity, intercepting runoff, and shading the watercourse. Bank stability is improved with the use of deep rooted binding plants. Flood control is also improved by providing vegetated overflow and backswamp areas. Bio-engineering solutions are the preferred option but site specific geotechnical reports may need to be prepared and the use of erosion/stability control devices employed that complements planting.

Secondary requirements for riparian restoration in the Lower Oratia catchment are;

- ◆ To provide areas for public use and enjoyment of the riparian zone by appropriate landscaping, park development, and improvement of views to the stream.
- ◆ To foster greater public understanding of the riparian environment and its ecological significance.

◆ To encourage public participation in the restoration and on going maintenance of the riparian zone.

These Riparian Restoration Guidelines outline typical stream profiles for the Twin Streams Project. The three main gradients are floodplains and backswamps, moderate slopes, and over-steepened banks. Each area has a specific restoration approach, including weed control strategy, planting regime, and maintenance program. Species lists are given for each of the gradients, as well as overall planting design guidelines so that the planted vegetation will look as natural as possible.

2.0 WEED CONTROL GUIDELINES

2.1 Strategy

The weed control strategy depends upon the species to be controlled and potential soil disturbance and follow on erosion effects. Specific guidelines for weed control are outlined in Waitakere City Council Weed Info Sheets. A full list of invasive species is contained in the document “Invasive environmental weeds of Waitakere”. Any species on this list should be managed with immediate or eventual eradication the goal.

Noxious exotic tree species such as pine, weeping willow etc will be addressed on a site by site basis and their removal will depend upon slope stability and amenity value. Some tree weeds may be left to stabilize banks while the replacement underplanting is growing. Replanting is required where large areas are cleared or where there is limited or no seed source in the immediate area.

Non-noxious exotic tree species (cedar, poplar, oak etc) are fine to stay, however, unsafe senescent (old and dying) exotic trees should be felled and replaced with appropriate natives. Senescent trees do provide valuable habitat, especially in the absence of mature native trees, therefore they should be kept as long as they are safe. Public consultation will be required for some significant trees.

Exotic grasses, dock, and other herbaceous or shrubby competitors for space and light are only an issue during early establishment of revegetation and require releasing not removal off-site as they help with moisture retention and soil stability.

Care must be taken with choice of herbicide. Roundup® G2 and Renew is the only chemical registered for foliar spray use near water. Other chemicals for control can be used when employing stump paint, cut and frill, or drill hole methods. The general policy near water is for manual control of small seedlings, with a follow up spray of Roundup on small resprouted seedlings, immediate replanting with natives, and follow up maintenance.

2.2 Erosion control

Erosion is kept to a minimum if the weed control regime is immediately followed by planting. In all areas, especially over steepened banks, suppression of non-noxious weeds through replanting is more desirable than total vegetation clearance. However, noxious material should be eradicated (except for selected tree species below) prior to but followed immediately by replanting.

Steep banks pose a problem for weed control operations and it is imperative that the weed control method with the least amount of soil disturbance is employed. Large weed species such as privet, tobacco weed, willow, and even pine should be progressively felled, leaving the trunk in the ground (poisoned if necessary) until alternative vegetation has established to take over soil binding properties. Tree privet and wattle may be crown lifted and underplanted until about year 5 when good native establishment is achieved.

Creeping vines and rhizomatous weed species such as bamboo, asparagus, tradescantia, and arundo should be manually cleared on steep banks and the soil immediately planted with species such as toetoe. Where soil stability is an issue progressive weed removal

may need to be used in conjunction with silt fences (see ARC guidelines) followed by planting at greater densities.

3.0 SPECIES SELECTION AND PLANTING

3.1 Objectives of species selection

Objectives relevant to species selection include;

- ◆ Suppression of weeds (both environmental weeds and weeds that may compete during the early restoration period).
- ◆ Establishment/enhancement of functioning ecosystem.
- ◆ Enhancement of local biodiversity (use of local species appropriate to the habitat and eco-sourced from local populations).
- ◆ Successful and rapid establishment.

3.2 Important colonizing species

There are a few colonizing species that play critical roles in the suppression of weeds and establishment of a functioning ecosystem;

Cabbage tree – Rhizomes combined with dense fibrous roots stabilise slopes and reduce surface erosion. Very effective at stabilizing over steepened slopes.

Mahoe – Strong stabilizing roots. Shade and sun tolerant.

Kanuka – Broad stabilizing root systems. Not shade tolerant.

Toetoe – Very drought tolerant. Retains moisture in the soil. Quick growing with a broad form, good for filling spaces between shrub shaped plants and suppressing both noxious and competitive weeds. Flexible plant therefore stable in the regular flood zone.

Cortaderia is tolerant of partial burying. This, with its drought tolerance, makes it a useful species for stabilizing over-steepened banks in combination with cabbage tree. The other features mean it promotes rapid establishment of other species, thus promoting rapid establishment of ecosystem functioning.

Where a ground binding plant is required in shady positions, gahnia species should be used instead of Cortaderia.

Other nurse species – eg. karamu, flax, manuka. Tolerant of open conditions and provide seed source. As flax does not lie flat during high flow events, it should not be planted in the regular flood zone but rather in bands or clumps above this zone.

3.3 Where native cover exists

The main objectives for areas where native cover or forest exists are to eradicate weeds, establish good edge vegetation, and interplant if additional stability is needed quickly or where species are locally extinct or missing from the forest cover.

Second stage species such as totara and puriri prefer stabilized conditions provided by the above colonizing species. They provide seed source and further stages of ecosystem development.

The ultimate success of a revegetation project is determined in part by the diversity achieved in the mature forest. While the species lists given in these guidelines are somewhat limited to readily established plants suitable for the Oratia Catchment, a

variety of other species can be introduced and may in fact colonise naturally from surrounding or nearby seed sources.

Mature forest has a diverse understory and the following plants could be introduced in sheltered sites; hangehange, gahnia, macropiper, and understory ferns.

3.4 Plant spacing

In the planting regime lists, plant spacings are given for the space between plants of the same species. For example,

Carex @ 50cm apart = 3 plants per square metre.

Cabbage trees and cortaderia @ 1m apart = 1 per 1m² of space.

In general, the higher half of the regular flood zone area should be cabbage trees and cortaderia, and the lower half (closest to the stream) a mix of Carex. This gives the following numbers;

Regular flood zone species (first 5m of stream bank on both sides of the stream).

Numbers given for 5 x 25m strip = 125m². The species by percentage area; Cortaderia 25%, Carex maorica 10%, Cordyline 25%, and Carex lessoniana 30% and Carex flagellifera 10% each.

Botanical Name	Common Name	Spacing	No. 5 x 25m
<i>Carex lessoniana</i>	rautahi	50cm (3/m ²) 30%	114 (38m ²)
<i>Carex flagellifera</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Carex maorica</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Cordyline australis</i>	cabbage tree	1m (1/m ²) 25%	31 (31m ²)
<i>Cortaderia fulvida</i>	toetoe	1m (1/m ²) 25%	31 (31m ²)

For moderate slopes and floodplains, the approach to numbers of plants is somewhat different. Canopy trees are allocated space first, then the area infilled with nurse plants.

Cortaderia are planted over 40% of the area at 1m apart, mainly on lower slopes. The other nurse trees are then interplanted at 1-2m spacings within the Cortaderia planting. Overall, a plant density one plant per 1m² (1m apart) is achieved.

Canopy trees need to be planted in nurse species at 5 to 8m apart from each other so that their proper form can develop. A semi-mature canopy tree would take up 25m² of space with a 5m wide crown. Therefore, an area of 375m² (15 x 25m strip) would fit 15 canopy trees. The canopy trees are planted in gaps in the nurse vegetation or where the colonizing shrubs are beginning to die off.

Forty percent of the nurse crop should be cortaderia, and the remaining area filled with the other nurse species (manuka, kanuka, hoheria, mahoe). Flax is planted in clumps or bands with 1m spacing above the regular flood zone.

For an area of 375m², this gives the following numbers;

Moderate slope stream bank above regular flood zone (numbers given for 15 x 25m strip = 375m²). An area of 375m² (15 x 25m strip) would fit 15 canopy trees. For 375m³, a total of 375 nurse species are to be planted with 150 cortaderia, two clumps of flax (50m² each), and the remaining area (125m²) in an even mix of the other nurse species.

Botanical Name	Common Name	Spacing	No. 15x25m
In open areas with no cover			
<i>Coprosma robusta</i>	karamu	2m	25
<i>Cortaderia fulvida</i>	toe toe	1m	150
<i>Hoheria populnea</i>	lacebark	2m	25
<i>Kunzea ericoides</i>	kanuka	2m	25
<i>Leptospermum scoparium</i>	manuka	2m	25
<i>Melicytus ramiflorus</i>	mahoe	2m	25

<i>Phormium tenax</i>	Flax	1m	100
Planted later in nurse crop cover			
<i>Alectryon excelsa</i>	titoki	5m	2
<i>Corynocarpus laevigatus</i>	karaka	8m	2
<i>Cyathea dealbata</i>	ponga	5m	2
<i>Dysoxylum spectabile</i>	kohekohe	10m	2
<i>Sophora microphylla</i>	kowhai	5m	3
<i>Podocarpus totara</i>	totara	8m	1
<i>Vitex lucens</i>	puriri	5m	3

3.5 General planting design

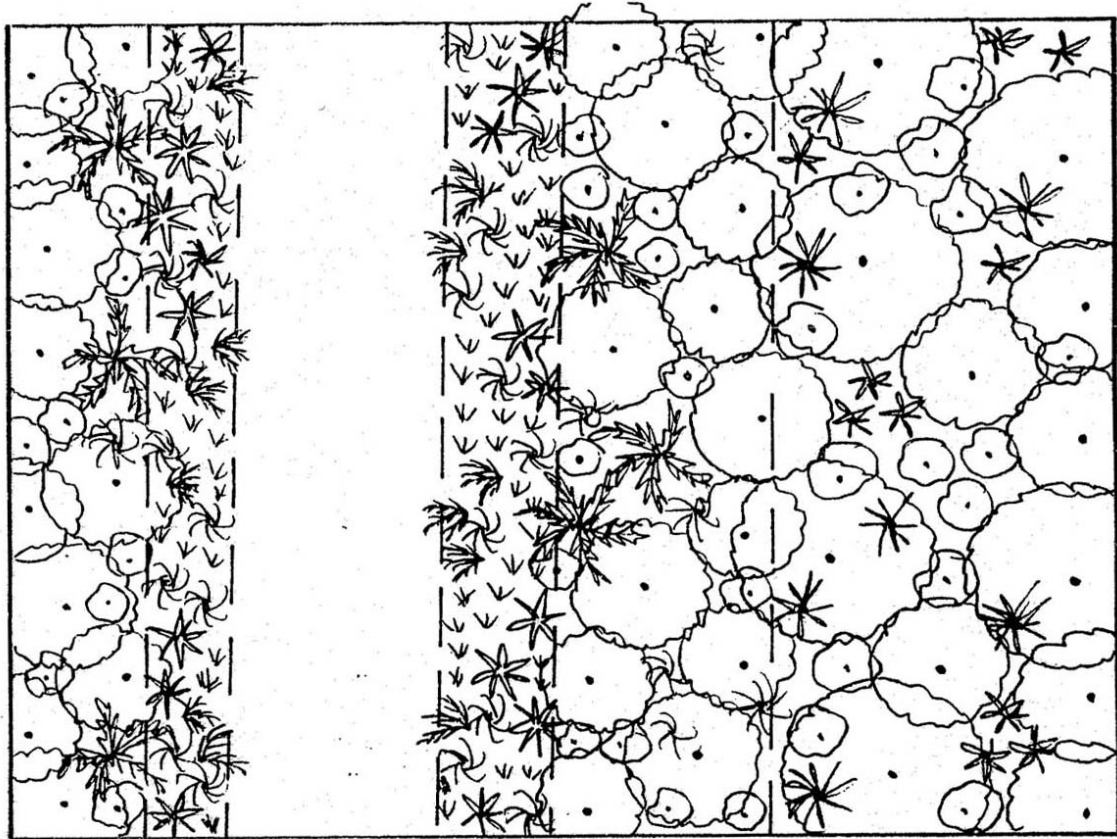
The figure below outlines a general planting design for the regular flood zone, moderate slope stream bank, and low crest with floodplain behind. The regular flood zone (first five meters of stream bank) is shown densely planted with *Carex* in the lower half and *Cortaderia* and *Cordyline* in the higher half. Plant these small grasses, sedges, and ferns in clumps and drifts rather than randomly throughout the area. Zonation also looks natural ie. Planting in bands and groups.

Stream banks, upper terraces, and floodplains require the establishment of nurse species before interplanting with canopy species. The main nurse species (manuka, kanuka, coprosma, cortaderia) should be evenly planted throughout the entire area with a final plant density of one plant per square metre.

In the figure below, canopy trees are shown at appropriate spacings, usually 5 to 10 meters apart, with nurse trees in between. Species such as ponga, cabbage trees, kahikatea and pukatea look best when planted in groups of three to five.

Low growing plants are underplanted throughout. The smaller plants such as hebe, rengarenga, flax, and karamu should be used more extensively along the edge of the planting so as to provide a tiered edge to the forest.

Landscaped areas may see the introduction of other species such as Hebe's, rengagenga, terrestrial grasses, and ground covers. Where views to the stream are to be maintained, lower growing and open branched species should be used eg. flax, cortaderia, grasses, fuchsia, kowhai.

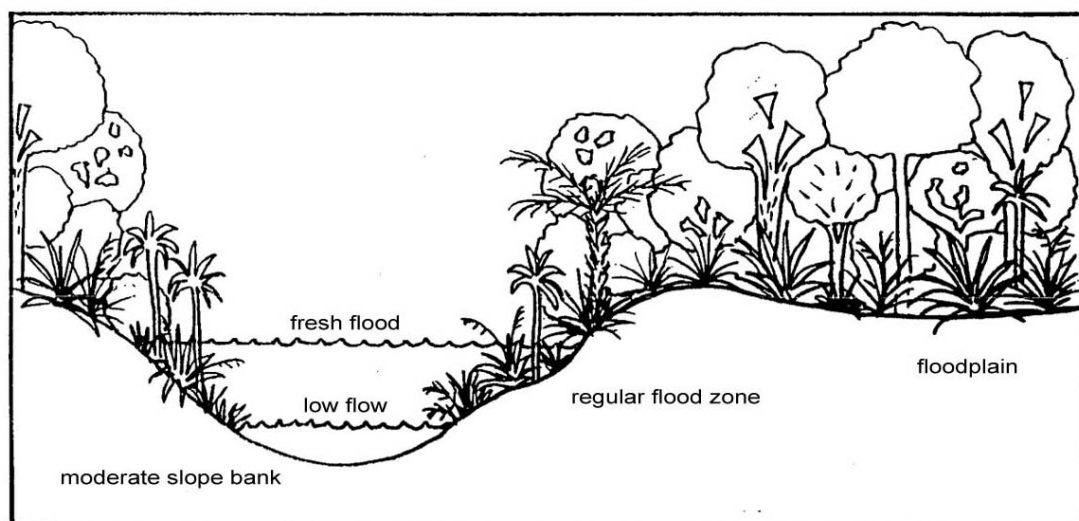


General Planting Plan
NTS

4.0 FLOODPLAINS

4.1 Typical stream profile

A large area of floodplain occurs in Site 11 of the Lower Oratia catchment. The crest of the stream bank is relatively low with a wide floodplain. Presently the area is in grass but has potential for landscaping to provide a communal park area with a variety of habitats. Floodplain areas are ideal for the establishment of species such as pukatea and kahikatea. The following figure outlines a typical cross section of this area – a moderate slope on one side and a low crest and floodplain on the other side.



Floodplain Section
NTS

4.2 Planting regime

Regular flood zone species (first 5m of stream bank on both sides of the stream).

Botanical Name	Common Name	Spacing	No. 5 x 25m
<i>Carex lessoniana</i>	rautahi	50cm (3/m ²) 30%	114 (38m ²)
<i>Carex flagellifera</i>		50cm (3/m ²) 10%	38 (12.5m ²)

<i>Carex maorica</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Cordyline australis</i>	cabbage tree	1m (1/m ²) 25%	31 (31m ²)
<i>Cortaderia fulvida</i>	toetoe	1m (1/m ²) 25%	31 (31m ²)

Moderate slope stream bank above regular flood zone – use the species list given in Section 5.0 Moderate Slopes.

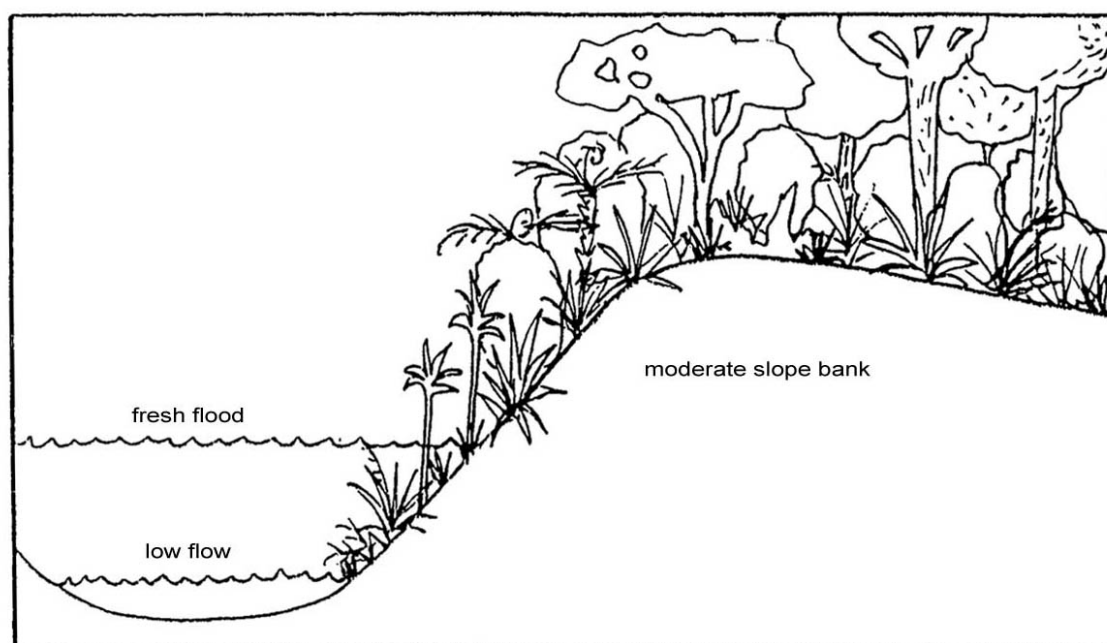
Floodplain species (numbers given for 10 x 25m strip = 250m²). An area of 250m² (10 x 25m strip) would fit 10 canopy trees. For 250m², a total of 250 nurse species are to be planted with 100 cortaderia, one clump of flax (50m²), and the remaining area (100m²) in an even mix of the other nurse species.

Botanical Name	Common Name	Spacing	No.10x 25m
In open areas with no cover			
<i>Cordyline australis</i>	cabbage tree	1m	33
<i>Cortaderia fulvida</i>	toe toe	1m	100
<i>Coprosma robusta</i>	karamu	1m	33
<i>Leptospermum scoparium</i>	manuka	2m	34
<i>Phormium tenax</i>	flax	1m	50
Planted in nurse crop cover			
<i>Dacrycarpus dacrydioides</i>	kahikatea	8m	3
<i>Laurelia novaezelandiae</i>	pukatea	8m	2
<i>Sophora microphylla</i>	kowhai	5m	3
<i>Syngium maire</i>	swamp maire	5m	2

5.0 MODERATE SLOPES

5.1 Typical stream profile

This stream profile is most common in the Lower Oratia catchment. The following figure outlines a typical cross section of this area – a moderate slope stream bank with a flat upper terrace.



Moderate Slope Bank Section
NTS

5.2 Planting regime

Regular flood zone species (first 5m of stream bank).

Botanical Name	Common Name	Spacing	No. 5 x 25m
<i>Carex lessoniana</i>	rautahi	50cm (3/m ²) 30%	114 (38m ²)
<i>Carex flagellifera</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Carex maorica</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Cordyline australis</i>	cabbage tree	1m (1/m ²) 25%	31 (31m ²)

<i>Cortaderia fulvida</i>	toetoe	1m (1/m ²) 25%	31 (31m ²)
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Moderate slope stream bank & upper terrace (numbers for 15x 25m strip = 375m²).

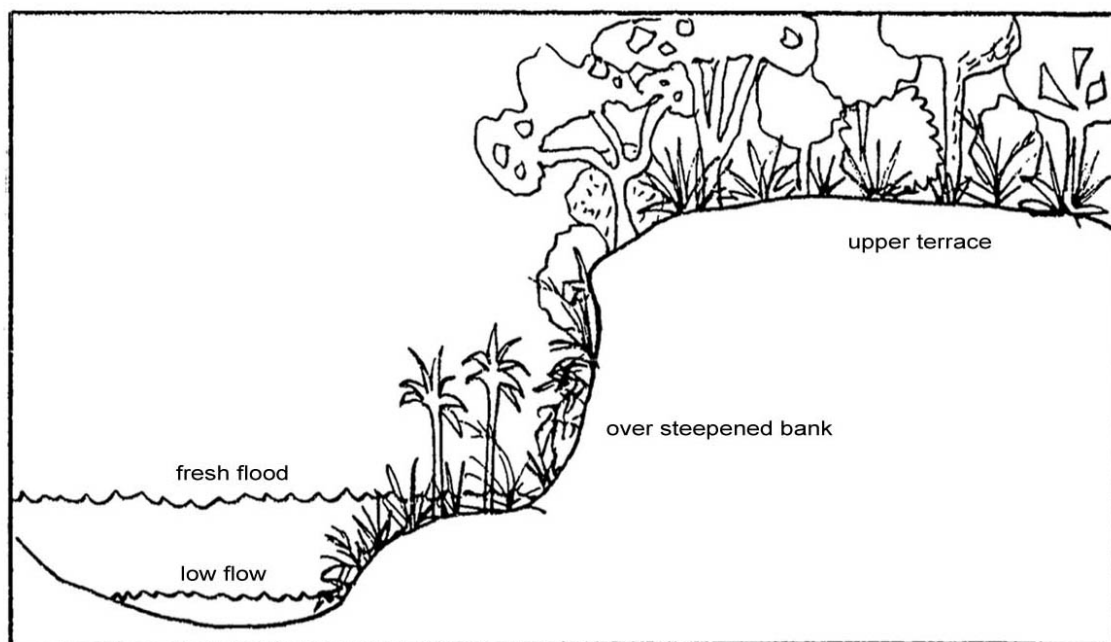
An area of 375m² (15 x 25m strip) would fit 15 canopy trees. For 375m³, a total of 375 nurse species are to be planted with 150 cortaderia, two clumps of flax above the regular flood zone (50m² each), and the remaining area (125m²) in an even mix of the other nurse species.

Botanical Name	Common Name	Spacing	No.15x25m
In open areas with no cover			
<i>Coprosma robusta</i>	karamu	1m	30
<i>Cortaderia fulvida</i>	toe toe	1m	150
<i>Hebe stricta</i>	hebe	1m	30
<i>Hoheria populnea</i>	lacebark	1m	30
<i>Kunzea ericoides</i>	kanuka	1m	30
<i>Leptospermum scoparium</i>	manuka	1m	30
<i>Melicytus ramiflorus</i>	mahoe	1m	30
<i>Phormium tenax</i>	flax	1m	50
Planted in nurse crop cover			
<i>Alectryon excelsa</i>	titoki	5m	2
<i>Corynocarpus laevigatus</i>	karaka	8m	2
<i>Cyathea dealbata</i>	ponga	5m	2
<i>Dacrydium cupressinum</i>	rimu	8m	2
<i>Dysoxylum spectabile</i>	kohekohe	10m	2
<i>Sophora microphylla</i>	kowhai	5m	2
<i>Podocarpus totara</i>	totara	8m	1
<i>Vitex lucens</i>	puriri	5m	2

6.0 OVER STEEPENED BANKS AND SLIPS

6.1 Typical stream profile

Several areas of over-steepened banks and slips occur along the Oratia creek and present a problem for both weed control and planting in that they are unstable areas subject to erosion. Access is difficult. Planting in these areas will depend upon existing cover. The following figure outlines a typical cross section of these areas – and undercut bank with associated over-steepening and an upper terrace area.



Over steepened bank section
NTS

6.2 Planting regime

Regular flood zone species (first 5m of stream bank).

Botanical Name	Common Name	Spacing	No. 5 x 25m
<i>Carex lessoniana</i>	rautahi	50cm (3/m ²) 30%	114 (38m ²)
<i>Carex flagellifera</i>		50cm (3/m ²) 10%	38 (12.5m ²)

<i>Carex maorica</i>		50cm (3/m ²) 10%	38 (12.5m ²)
<i>Cordyline australis</i>	cabbage tree	1m (1/m ²) 25%	31 (31m ²)
<i>Cortaderia fulvida</i>	toetoe	1m (1/m ²) 25%	31 (31m ²)

Over-steepened banks (numbers depend upon area of rock etc). Note: Possum control required for fuchsia.

Botanical Name	Common Name	Spacing	No.
<i>Blechnum sp.</i>		50cm	
<i>Coprosma robusta</i>	karamu	1m	
<i>Gahnia sp.</i>		1m	
<i>Polystichum vestitum</i>	shield fern	50cm	
<i>Fuchsia excorticata</i>	kotukutuku	5m	
<i>Kunzea ericoides</i>	kanuka	1m	
<i>Sophora microphylla</i>	kowhai	5m	

Upper terrace (numbers given for 15 x 25m strip = 375m²).

Botanical Name	Common Name	Spacing	No.15x25m
In open areas with no cover			
<i>Coprosma robusta</i>	karamu	1m	40
<i>Cortaderia fulvida</i>	toe toe	1m	150
<i>Hebe stricta</i>	hebe	1m	25
<i>Hoheria populnea</i>	lacebark	2m	40
<i>Kunzea ericoides</i>	kanuka	2m	40
<i>Leptospermum scoparium</i>	manuka	2m	40
<i>Melicytus ramiflorus</i>	mahoe	1m	40
Planted in nurse crop cover			
<i>Alectryon excelsa</i>	titoki	5m	3
<i>Corynocarpus laevigatus</i>	karaka	8m	3

<i>Dysoxylum spectabile</i>	kohekohe	10m	3
<i>Sophora microphylla</i>	kowhai	5m	5
<i>Podocarpus totara</i>	totara	8m	1

REFERENCES

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Chapple,D., Ebbett,R., Kitson,I. (2003) “Greening our Gulf Islands”.

Waitekere City Council Weed Control Info Sheets.

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