CHAPTER 10

REVEGETATION

BEVERLEY CLARKSON AND MONICA PETERS

CONTENTS


REVEGETATION

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BEVERLEY CLARKSON AND MONICA PETERS

Many of New Zealand's iconic wetland species are endemic, i.e. found nowhere else in the world. Examples of such species include kahikatea (*Dacrycarpus dacrydioides*), swamp maire (*Syzygium maire*), cabbage tree (*Cordyline australis*), red tussock (*Chionochloa rubra*), purei (*Carex secta*), and cane rush (*Sporadanthus ferrugineus*), which often dominate large areas to form distinctive vegetation types. Wetlands also contain a disproportionately high number of New Zealand's threatened plants and animals, a consequence of extreme habitat loss and ongoing human-induced degradation. Restoration of wetland structure and function is therefore extremely important to provide suitable habitat for wetland species and ensure that biodiversity values will be preserved for future generations.

The most common action undertaken for restoration of wetlands is revegetation. In most cases this involves removal of introduced weeds, such as willow, and then the planting of native species appropriate to the habitat conditions and region. Revegetation frequently focuses on increasing scenic, biodiversity, or functional values of the wetland site. Whatever the reason, there are a few key steps to follow to ensure your revegetation project is successful.

Previous page: The ripe seeds of the cabbage tree (*Cordyline australis*).
Photo: Monica Peters, NZ Landcare Trust

Involving the community helps with planting out and aftercare as well as providing a valuable opportunity to educate the public about wetlands.
Photo: Abby Davidson, NZ Landcare Trust

The Battle Hill Farm Park in Wellington is a working farm that also showcases a wide range of wetland restoration initiatives.
Photo: Monica Peters, NZ Landcare Trust

1 Restoring your wetland

1.1 Developing a Wetland Restoration Plan

A Wetland Restoration Plan is extremely useful for gathering information about the restoration site, clarifying goals and objectives and guiding restoration activities. Either use an existing template (see the Useful websites section at the end of the chapter) or create your own based on the steps outlined below.

1.1.1 Mapping

An effective starting point for developing a Wetland Restoration Plan is a sketch map. A bird's-eye view sketch map is important as it helps to summarise knowledge about the natural and/or man-made features of the restoration site. It is a practical tool for defining, for example, management zones and locations of permanent plots for monitoring. The map can be hand drawn using a range of resources such as aerial photos, topographic maps and Google Earth combined with your own knowledge.

The following features should be included:

- Vegetation types
- Water sources and outflows, hydrological modifications, water level
- Soil type(s)
- Natural, man-made and cultural features

For more detail on what to include, see Chapter 2 – Restoration planning

1.2 Determining wetland type

Find out what type your wetland is/was, e.g., marsh, swamp, fen, bog, ephemeral, because different wetland types have specific nutrient and hydrological regimes that favour distinctive plant communities. Note that larger wetlands may be made up of more than one wetland type. This information will provide a framework for the most appropriate species and environmental conditions to aim for (See Chapter 2 – Wetland types).

1.3 Understanding the site

You can get some clues on wetland type from what native plant species remain in your wetland, and from the soil type (e.g., presence of peat), by visiting similar wetlands in the vicinity, or researching historical records. A little bit of investigation on the relevant wetland type in your region should also reveal information on the typical or main vegetation communities, habitats, plant and wildlife species, and rare species, which can help focus your restoration project. Further information on finding and using reference wetlands along with a range of other useful information from, e.g., historical sources can be found in Chapter 4 – Site interpretation 1 and Chapter 5 – Site interpretation 2.

1.4 Setting realistic goals and objectives

Set goals that are achievable. An overall goal for revegetation may centre on re-establishing vegetation cover characteristic of the original wetland type. As the restoration progresses and the first plantings mature, short-term goals can be refined – see Chapter 2 Goals and objectives for advice.

Specific objectives linked to revegetation goals could be to:

- provide food and habitat for wetland birds
- reintroduce plant species that have historically been present
- develop a useable resource of culturally important species for fibre and medicine
- re-establish peat forming species (in bogs)
- create a seed source for other local wetland restoration projects
- establish a buffer to trap sediments and process nutrients from the surrounding catchment

Right: Flax harvested from Punawhakaata wetland, South Taupo.
Photo: Monica Peters, NZ Landcare Trust

1.4.1 Keeping it legal

If your wetland restoration site is located on Department of Conservation land and you want to introduce native plants not currently found there, then a species translocation permit is required. All translocations of native species are under the control of the Department of Conservation, and must adhere to the strict guidelines set out in the 'Standard Operating Procedure for Translocation of New Zealand's Indigenous Flora and Fauna', 2002. Contact the Department of Conservation for further information.

The cultural harvest of plants such as flax and raupo may also require a permit from the Department of Conservation if the activity takes place on DOC administered sites.

2 Planting zone map

The wetland sketch map opposite shows the site in its current state and includes the planting zones as detailed in Table 1. The concept diagram overleaf shows the same site with restored vegetation appropriate to the planting zones. The diagram summarises the overall planting aims for the site and provides an indication of how it might look 10–20 years after restoration.

Intact vegetation sequence from swamp in the valley to dryland on the slopes, Waikato. Photo: Monica Peters, NZ Landcare Trust

Table 1. Planting zones

A = Aquatic • Permanent open water usually >1 m deep • Plants are submerged entirely except for flowering parts. They may be floating or rooted and will generally not survive dry-down conditions • Aquatic plants are established as tubers, rooted plants, or plant fragments
E = Emergent • Shallow water usually 5 cm – 1 m deep • Plants are partially submerged with leaves, stems and flowering parts partially or entirely out of the water • Emergent plants are generally installed as plants. When planted, they need to have a portion of their leaves or stems above the water surface or they will drown • If seeded, the seed should be placed either on a mud flat or at the water's edge
S = Saturated • Soils are saturated most of the year with water levels averaging –5 cm to +5 cm, i.e. at or near the ground surface • Plants will tolerate periodic flooding and dry-down periods • 'Saturated' species can be established as plants or seeds and grow well at the water's edge
M = Moist • Moist soils are saturated seasonally with flooding in winter, or after periods of heavy rain, and dry-down in summer • Species can be established as plants or seed
MZ = Mesic • Upland soils may be saturated for short periods of time but are generally dry • Many mesic species will tolerate saturated and moist conditions for extended periods of time • Species are established as plants or seed
D = Dry • Upland soils on slopes or free-draining sites that are generally dry • This non-wetland zone usually supports forest and shrub species

Links to planting guides are included in the reference section at the end of the chapter.

Figure 1. Wetland sketch map including planting zones. Drawing: Monica Peters, NZ Landcare Trust

Once weeds are suppressed with densely planted manuka, small areas can be opened out to allow for enrichment planting, including other native species requiring sheltered conditions to establish. Awhitu Regional Park, Auckland. Photo: Monica Peters, NZ Landcare Trust

Heritage weaving flaxes sourced from the Rene Orchiston collection are being grown in partnership with Ngaati Te Ata at the Earthtalk@Awhitu restoration project, Auckland. Photo: Tanya Cumberland, Earthtalk@Awhitu

Lake Serpentine east and catchment, Waikato, showing all 6 planting zones detailed in Table 1.
Photo: Monica Peters, NZ Landcare Trust

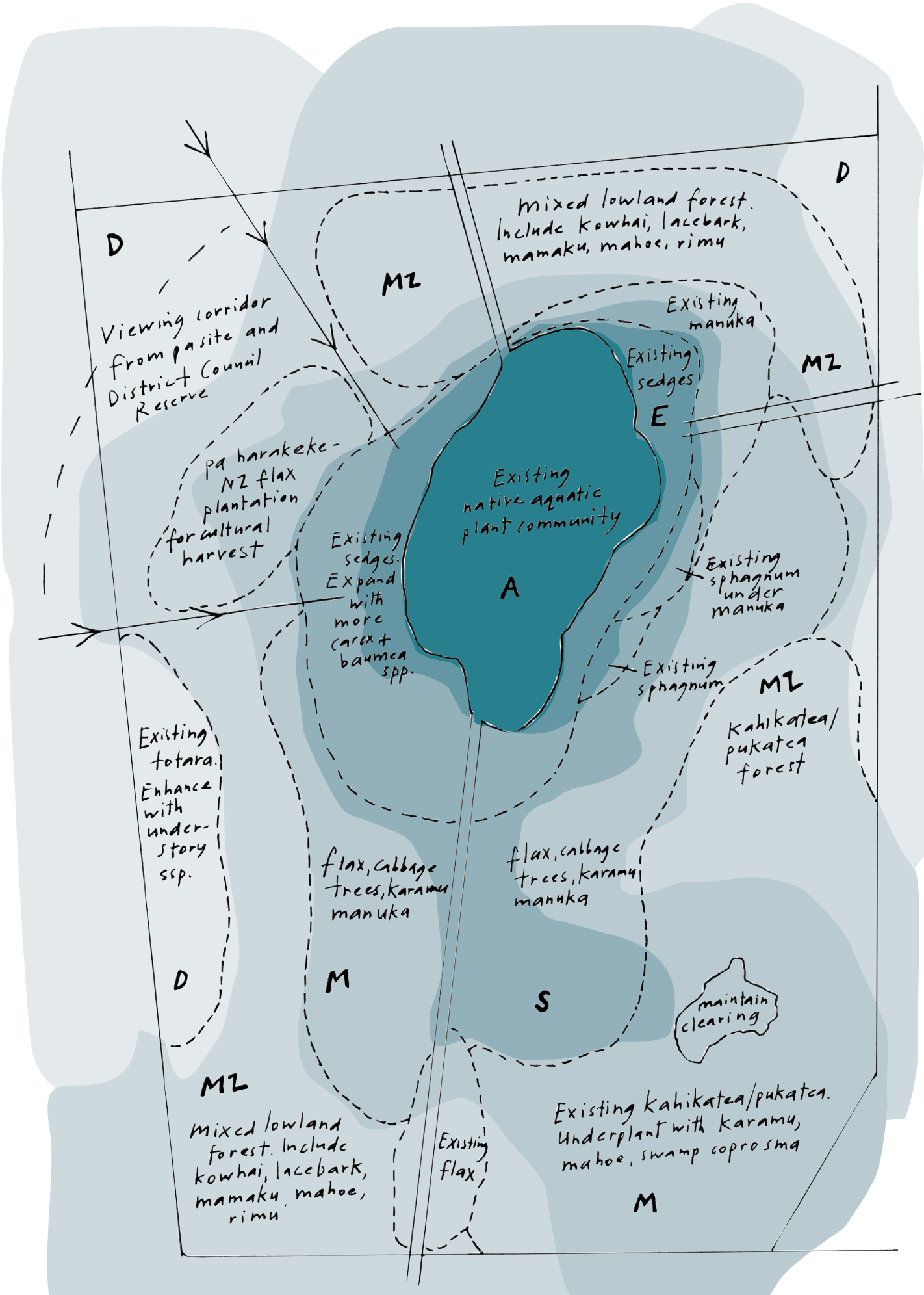


Figure 2. Planting concept map showing the site after restoration. Drawing: Monica Peters, NZ Landcare Trust

2.1 Wetland species planting zone guide

Table 2. Wetland species and their planting requirements

Planting zone	Common name*/Botanical name	Wetland type/habitat	Installation	Additional planting zone
A = Aquatic	duckweed *Lemna minor*	shallow water, swamp	plants	
	pondweed *Potamogeton cheesemanii*	shallow water, swamp	plants	
	water milfoil *Myriophyllum propinquum*	shallow water, swamp	plants or fragments	
E = Emergent	jointed twig rush *Baumea articulata*	shallow water, lake edge	plants	Also shallower parts of A
	kuawa *Schoenoplectus tabernaemontanii*	shallow water, lake edge	plants	
	kuta, tall spike sedge *Eleocharis sphacelata*	swamp, shallow water, lake edge	plants, seeds, or rhizomes	Also shallower parts of A
	marsh clubrush *Bolboschoenus fluviatilis*	lake edge	plants or rhizomes	
	raupo *Typha orientalis*	swamp, shallow water, lake edge	plants or rhizomes	Also shallower parts of A

*Note that common names and Maori names for plants can vary between regions

E = Emergent Kuta. Photo: Monica Peters, NZ Landcare Trust

E = Emergent Raupo.
Photo: Monica Peters, NZ Landcare Trust

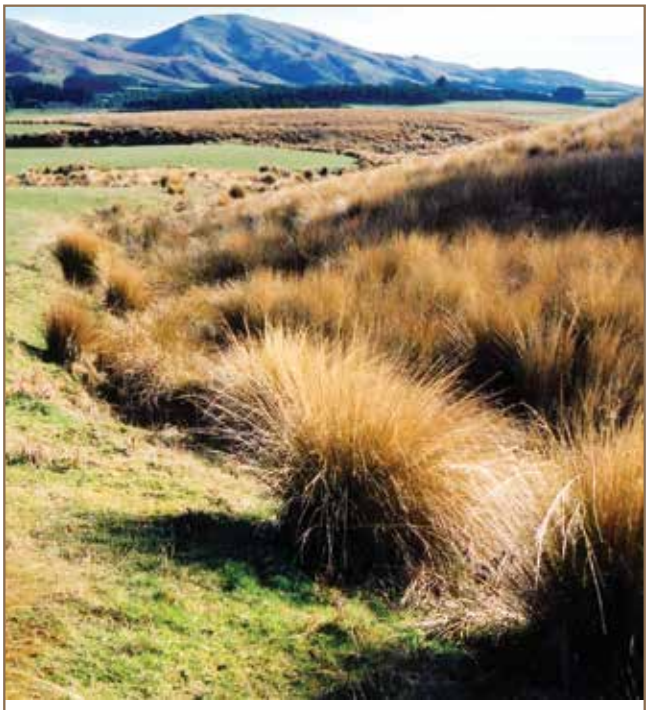
A = Aquatic Water milfoil.
Photo: Monica Peters, NZ Landcare Trust

Table 2. Wetland species and their planting requirements

Planting zone	Common name*/ Botanical name	Wetland type/habitat	Installation	Additional planting zone
S = Saturated	baumea *Baumea arthrophylla*	swamp, lake edge	plants or rhizomes	Also shallower parts of E
	baumea *Baumea rubiginosa*	swamp, fen	plants or rhizomes	
	cabbage tree, ti kouka *Cordyline australis*	swamp, fen	plants, seeds	Also M
	harakeke, NZ flax *Phormium tenax*	swamp, fen	plants (can be divided), seeds	Also M
	mingimingi *Coprosma propinqua*	swamp	plants, seeds	Also M
	pakihi sedge *Baumea teretifolia*	fen, bog	plants or rhizomes	
	pukio *Carex virgata*	swamp	plants	Also M
	purei/pukio *Carex secta*	swamp, lake edge	plants (can be divided), seeds	Also shallower parts of E
	red tussock *Chionochloa rubra*	fen, bog	plants (can be divided), seeds	Also M
	swamp coprosma *Coprosma tenuicaulis*	swamp, fen,	plants, seeds	Also M Prefers shelter
	waiwaka, swamp maire *Syzygium maire*	swamp	plants, seeds	Also M Requires shelter Frost-prone
	wire rush *Empodisma minus*	bog	plants	

*Note that common names and Maori names for plants can vary between regions

S = Saturated *Baumea* community with cabbage trees. Photo: Monica Peters, NZ Landcare Trust



S = Saturated Red tussock.
Photo: Aalbert Rebergen, Otago Regional Council

S = Saturated Harakeke/ NZ flax community.
Photo: Monica Peters, NZ Landcare Trust

M = Moist Manuka with bracken.
Photo: Monica Peters, NZ Landcare Trust

Table 2. Wetland species and their planting requirements

Planting zone	Common name*/ Botanical name	Wetland type/habitat	Installation	Additional planting zone
M = Moist	kahikatea *Dacrycarpus dacrydioides*	marsh, swamp	plants, seeds	Also MZ
	karamu *Coprosma robusta*	marsh, swamp	plants, seeds	Also MZ
	manuka *Leptospermum scoparium*	marsh, swamp, fen, bog	plants, seeds	Also S, MZ
	pokaka *Elaeocarpus hookerianus*	marsh, swamp	plants	Also MZ
	pukatea *Laurelia novae-zelandiae*	marsh, swamp	plants	Also MZ
	toetoe *Cortaderia toetoe* *C. richardii*	marsh, swamp	plants (can be divided)	Also MZ,
	wheki *Dicksonia squarrosa*	marsh, swamp, fen	plants, spores	Also MZ
MZ = Mesic	kowhai *Sophora microphylla*	marsh, swamp edge	plants, seeds	
	lacebark *Hoheria sexstylosa* *H. populnea*	marsh, swamp edge	plants, seeds	
	Mahoe, whiteywood *Melicytus ramiflorus*	marsh, swamp edge	plants, seeds	
	mamaku *Cyathea medullaris*	marsh, swamp edge	plants, spores	
	rimu *Dacrydium cupressinum*	marsh, swamp edge	plants	
D = Dry	Forest/shrub species			

*Note that common names and Maori names for plants can vary between regions

M = Moist Wheki-ponga. Photo: Monica Peters, NZ Landcare Trust

MZ = Mesic Rimu with tree ferns. Photo: Monica Peters, NZ Landcare Trust

M = Moist Pukatea. Photo: Monica Peters, NZ Landcare Trust

3 Planting

From the planting zone map, work out the approximate area of each zone to be planted. Compile a list of species for each zone characteristic of your region, with approximate proportions according to microtopography (e.g., narrow *Carex secta* fringe close to water's edge, merging into a harakeke/NZ flax zone behind). Try to replicate an existing natural wetland of the same type in the region; however, bear in mind that some species will require the shelter of other plants to become successfully established (see Section 3.1.1 – Ecological succession). Using the approximate planting rate of 1–3 plants per square metre depending on initial and final size, calculate the number of plants required for planting. Although some zones may typically be dominated by one species, include a range of species where possible to increase biodiversity benefits, e.g., bird attractants (see chapter 12 – Native fauna).

3.1 Ecosourcing

Use ecosourced plants where possible as these are adapted to local growing conditions. A range of commercial and community nurseries now specialise in ecosourcing. Propagating your own plants from seeds and cuttings ensures certainty of plant origins and is extremely cost-effective. Involving a local school can be mutually beneficial. Larger operations can also provide employment and horticultural training for members of the local community. Collecting and growing on small seedlings or vegetative fragments (e.g., rhizomes), and dividing grasses and sedges are other useful propagation techniques.

3.1.1 Ecological succession

Understanding ecological succession is an important part of developing a planting plan. Succession is the process whereby one plant community gradually changes into another. It involves both arrivals and losses of species, coupled with changes in the relative abundance of different plants. This process is brought about by changes in environment and biotic interactions, e.g., declining light levels, competition. Wetland species that can cope with full sun, exposed and/or frosty conditions are typical of early succession and can be planted in the first crop. They are usually hardy, fast-growing species that often attract birds to encourage natural seeding of other native species. They will provide protection for later successional plants that are slower growing, more shade tolerant, and more susceptible to frost and wind. Most wetland species can be planted in the first successional stages but a few, e.g., swamp maire and pukatea, perform better later, within a nurse crop. Others, e.g., mahoe, *Coprosma rotundifolia*, and mamaku are susceptible to frost, and in frost-prone areas will require shelter from other plants. Epiphytes (perching lily), climbers/scramblers (kiekie) and some small ground cover species (*Nertera* spp.) also establish better in later successional stages. Enhancement planting of later successional wetland species may be required for restoration projects that do not have seed-source wetlands nearby.

Educating the public about succession in Seeley's Gully, Hamilton.
Photo: Monica Peters, NZ Landcare Trust

Kuta (*Eleocharis sphacelata*) and kuawa (*Schoenoplectus tabernaemontanii*) establish readily from divided plants.
Photo: Wildland Consultants Ltd.

Hamilton City Nursery has created simple shallow lined pools for propagating wetland plants. Azolla helps keep the water from stagnating. Photo: Monica Peters, NZ Landcare Trsut

WHY USE ECO-SOURCED PLANTS?

By planting eco-sourced native plants you will:

- help maintain the unique local characteristics of native plants in your region
- protect the local character of natural plant communities from being swamped by plant forms from other areas
- obtain plants that have a greater chance of growing successfully because they are adapted to the local conditions

HOW ARE ECO-SOURCED PLANTS GROWN?

"First the planting site is identified, for example, a wetland in Hamilton. Seed is then collected from local native plant populations growing as close to that site as possible in wetland habitats. Seed is collected from as many plants as possible for each species to obtain a broad genetic base. If there is little or no seed material meeting these criteria for a particular species, seeds may be able to be collected from adjoining catchments or ecological districts."

– *Wayne Bennett, Eco-sourced Waikato*

CASE STUDY

Newly planted natives on the edge of the wetland are marked with bamboo poles (photo taken 2007).
Photo: Nicky Eade, Marlborough District Council

AMONG THE GRAPEVINES: REVEGETATING THE RAPAURA WETLAND

The privately owned Rapaura wetland (3 ha) is regarded as "one of the best examples remaining of a spring fed wetland in the lower Wairau Valley". The owners were attracted to the property both for its wetland and for the potential of the dry areas to become vineyards. A survey under the Marlborough District Council's (MDC) Significant Natural Areas (SNA) programme revealed a single mamaku fern (*Cyathea medullaris*), a surprise find on the otherwise arid plains. The mamaku was surrounded by a dense stand of crack willow (*Salix fragilis*).

The landowners, in recognizing the potential of the wetland, had already begun with weed removal, using machinery to take out a number of willows before the SNA survey in 2003. At this stage, a detailed Management Plan (using a contract consultant funded by the Council) was developed through the MDC's Landowner Biodiversity Assistance Programme. The plan divided the 3-ha area into zones and set up a three-stage restoration programme for the wetland. The two main tasks identified were weed control and restoration planting.

Stage one (2005)

Vigorous willow regrowth and other weeds, including old man's beard (*Clematis vitalba*), barberry (*Berberis glaucocarpa*), broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), and Japanese honeysuckle (*Lonicera japonica*), were sprayed with glyphosate. Spring plantings were preceded and followed by release spraying (2 months before and c. 2 months after). Stage one total cost: c. $5,000.00 shared between MDC and the landowner.

Stage two (2006)

Further willow was removed, regrowth and other weeds were sprayed. A total of c. 5000 plants were planted. Stage two total cost: $35,000.00 shared between the government Biodiversity Fund (50%), Council (25%), and the landowner (25%).

Stage three (2008)

A further 3300 plants were planted, general maintenance and weed control were carried out. Stage three total cost c. $12,000.00 (shared 50/25/25 as above).

What's been planted?

To date, a diverse range of around 9500 native plants have been used to revegetate the wetland. Species that have been planted include harakeke/NZ flax (*Phormium tenax*), toetoe (*Cortaderia richardii*), kowhai (*Sophora microphylla*), manuka (*Leptospermum scoparium*), carex species, cabbage tree (*Cordyline australis*), akeake (*Dodonea viscosa*), small-leafed coprosmas, hebes, olearia, kohuhu, and lowland ribbonwood (*Plagianthus regius*). Kahikatea (*Dacrycarpus dacrydiodes*) seedlings were sourced from the only remaining grove on the Wairau Plain. The MDC's Landowner Assistance Programme helped the owners apply for funding for revegetation and weed control. The landowners have dedicated much time and effort to weed control and plant aftercare – both of which are major tasks.

REF: www.marlborough.govt.nz/Environment/Land/Publications-and-Reports/~/media/Files/MDC/Home/Environment/Land/NewsletterSNAFebruary2007NEa.ashx

3.2 Site preparation

Prepare your site for planting or seeding by controlling weeds or invasive species using herbicide or physically removing them (see Chapter 9 – Weeds). In some cases, such as where areas of paddock are being retired for incorporation into wetland margins, light grazing before planting can be carried out. For spot planting, clear a circular patch up to 1-m diameter for each plant. For major weed infestations, you may have to start weed control well ahead of planting. The best time to plant the site is late summer/early autumn when water levels are lowest. In some cases, planting may be carried out virtually any time of the year if the site retains enough moisture and does not receive heavy frosts in the winter.

Kahikatea seed.
Photo: Colin Webb, Landcare Research

Shade cloth laid out underneath kahikatea to collect falling seeds (season: Feb—Apr). Photo: Wildland Consultants Ltd

3.3 Planting methods

The following sections outline common methods for planting. Factors to consider include:

- Goals and objectives, e.g., native canopy cover in 3–4 years in a given management zone
- Planting budget
- Availability of plants of the desired size
- Nature of management zone, e.g., degree of weed infestation, types of weeds present, access
- Available labour and time for site preparation, planting out, and aftercare

Planting can be dramatically sped up with this novel hydraulic hole-puncher which pulls PB3-sized plugs out of the ground.
Photo: Alec Bennett, Lake Cameron Care Group

Growing from eco-sourced seeds requires a lot of prior planning to ensure plants are big enough to use when required. Pauatahanui, Wellington. Photo: Monica Peters, NZ Landcare Trust

3.3.1 Using seeds

Sowing eco-sourced seeds directly onto the wetland is possible if the site has been well prepared. Thorough weed control is essential for this method to be successful, as germinating native seedlings tend to be out-competed by faster growing introduced species. In many cases seed sowing is used in conjunction with plantings. For example, once a native cover has been re-established by initial plantings, sowing seeds by hand is a cheaper and less labour-intensive way of increasing species diversity. Use freshly collected seed, as viability in most species declines rapidly once the seed is harvested.

Wetlands also have a seed bank that can supplement plantings and add diversity. Often just clearing a dense overstorey of willow or other introduced plants will release the seed bank. *Carex secta*, for example, has a long-lasting seed bank and will often germinate in large numbers following clearing and opening canopy gaps. However, also be aware of the possibility of a flush of exotic species, which may also respond to the enhanced light or other changes in environmental conditions.

3.3.2 Using planter bags and/or root trainers

Most revegetation projects involve planting 1–2-year-old plants (usually the larger the better) grown in planter bags (PBs) or similar containers either from seed, rhizomes or divisions (see Table 1. Wetland species and their planting requirements).The following principles apply to both PBs and root trainers. Just before planting, water plants thoroughly and then set them out with desired spacing in the appropriate planting zones according to your concept map. When planting, dig a hole larger than the root ball to ensure plenty of growing space. Remove the plant from the container, loosen or clip the roots if root bound, insert the plant in the hole, replace the soil around the plant, and finish by heeling in firmly. Fertiliser is not recommended for wetland plantings, particularly in fens and bogs that have inherently lower nutrient levels, as this may promote

ROOT TRAINERS (RTs) vs PLASTIC BAGS (PBs) – WHICH TO USE?

Use root trainers (RTs) when:

- site is not too cold in winter or too dry in the summer, particularly in the year of planting
- plants can be well cared for during delivery and until planting
- weed control and releasing are undertaken diligently and in a timely fashion
- fast results are required – at 8000–10000 RT/ha, canopy closure = 2–4 yrs
- costs need to be minimized – RTs are cheaper to buy, easier to move around a site and quicker to plant than PBs

Use planter bags (PBs) when:

- species are not suited to being produced in RT grades (or are less likely to survive as RTs)
- site conditions include severe winter frosts, irregular/out of season frosts, summer droughts or wind
- there are weeds or competitive grasses that cannot be readily suppressed (e.g., kikuyu)
- there are herbivorous pest animals that cannot be effectively controlled (e.g., hares)
- there is a lower standard of site preparation
- there is likely to be less frequent maintenance
- wider spacings can or need to be used, meaning fewer plants are required (generally meaning a longer time until canopy closure)

– *Sarah Beadel, Wildland Consultants Ltd*

increased weed growth. Surround the plant with mulch, compost, bark chips or similar to keep the weeds down and the soil moist, and water the plants in drier sites. A variety of methods such as plastic sleeves or cloches can be used to promote plant establishment and exclude problematic weedy species. Mark each plant with a bamboo stake for easy relocation later. Dipping the ends of the bamboo stakes in brightly coloured paint will make them easier to see.

REVEGETATION: TOP TIPS FROM THE COMMUNITY

- Ensure good site access: quality tracks for planting and on-going maintenance are a must
- Don't plant more than you have the manpower to maintain
- Harden off trees thoroughly before planting
- Sensitive plants, e.g., puriri and some tree ferns (e.g., *Cyathea* spp.) may require protection from frost and sun damage
- Use plant stakes 60 cm and taller, and biodegradable ties, e.g., cut up t-shirts
- Use dense or prickly plants to discourage vandalism of/entry into sensitive areas
- If you can't see any improved results in 4 years, then you may need to rethink what you are doing

3.4 Aftercare

Your plantings will need on-going maintenance. Probably the most time-consuming task will be releasing or removal of weeds from around the plantings. Removal using a tool like a grubber or slasher, or hand pulling is effective in small areas. In larger areas, herbicides are often used (see Chapter 9 – Weeds).

After care will probably also involve pest control (see Chapter 11 – Pests) and animal exclusion, e.g., fencing, plastic sleeves or boxes. Introduced browsing animals, e.g., possums, goats, rabbits, hares, cattle, etc., will target recent plantings of nursery-grown plants as these provide rich sources of nutrients. In addition, rats will devour viable seeds that are important for seed banks and the ongoing viability of your wetland. Birds such as pukeko, though native to New Zealand and a natural part of a wetland ecosystem, may undo a lot of your restoration work by nibbling and uprooting plants. To deter pukeko, use larger and heavier potted plants and try placing a hedge of short sticks or some other form of barrier around young plantings.

Keep a record of any plant losses and the reasons you think they might have died. For example, if a microsite appears too wet for plants to grow, plant a more water-tolerant species there, or mound up the soil so the plant roots are not so waterlogged.

Rigid plastic sleeves are suitable for larger plants and pegged using stakes. Te Hapua, Wellington. Photo: Monica Peters, NZ Landcare Trust

A plastic sleeve fitted over two U-shaped wire frames anchored into the ground exclude problem weeds and pests. Fensham wetland, Wellington. Photos: Beverley Clarkson, Landcare Research

Spray shield constructed from an old plastic container.
Photo: Environment Waikato

Old fertiliser bags can used as weed matting and pegged around the bases of new plants. Otatara, Southland.
Photo: Monica Peters, NZ Landcare Trust

CASE STUDY

TRAVIS WETLAND RESTORATION: THE MULTIPLE USES OF NATIVE PLANTS

Travis Wetland (119 ha) is the largest freshwater wetland in Christchurch. A comprehensive Landscape Development Plan was developed in 1998 to transform the wetland, which was partially dominated by willow with areas of open pasture. To date, more than 60 000 plants have been planted out, with thousands more propagated by a keen group of Travis Wetland Trust members.

Providing habitat for birds

Dense fringing vegetation is made up of harakeke/NZ flax (*Phormium tenax*), raupo (*Typha orientalis*), sedges, e.g., purei/pukio (*Carex secta*), clubrush (*Bolboschoenus caldwellii*), kuawa (*Schoenoplectus tabernaemontanii*), and rushes (*Juncus* spp.). These plants function as islands when water levels are high and provide waterfowl with nest sites, shelter and food (insects and plant material). They also help provide shade over the water – a means of reducing eutrophication. Existing crack willow and male grey willow are kept as they provide nursery conditions for kahikatea forest seedlings and interim roosts. Tall trees, mostly kahikatea, have been planted and will eventually provide roosting and nesting sites for birds.

Reducing nutrient impacts

In riparian zones, plants help reduce the chances of algae forming by intercepting nutrients and promoting zooplankton. Plantings include rushes (*Juncus gregiflorus, J. sarophorus, J. pallidus*), sedges (*Carex virgata, C. secta, C. coriacea, C. maorica*), umbrella sedge (*Cyperus ustulatus*), toetoe (*Cortaderia richardii*), ferns (*Blechnum minus, Polystichum vestitum*), raupo (*Typha orientalis*), and kuawa (*Schoenoplectus tabernaemontanii*).

Maintaining native turf plants

Paddocks have been fenced as grazing marsh. Cattle are grazed between October and April when the ground is drier to minimize pugging – with mixed success as some areas never harden up. Strong fences, gates and culverts over drains prevent access to sensitive areas. Mowing of some grazed and ungrazed areas is carried out in late summer or early autumn following the nesting season to maintain a short grassland and control dock, hemlock, and thistles. Canada geese are useful grazers and numbers of up to 1600 birds maintain a short grass sward from late autumn and winter. Several native pond margin species appear to have benefited from this grazing regime, such as button daisies (*Leptinella dioica, L. maniototo*). Recently, attempts are being made to establish other turf formers in the grazing marsh, namely *Gunnera dentata*, pratia (*Lobelia angulata*), and dwarf musk (*Mazus novaezelandii*).

Screening public access areas

Kahikatea (*Dacrycarpus dacrydioides*) and pokaka (*Elaeocarpus hookerianus*), along with smaller, faster growing species including karamu (*Coprosma robusta*), mingimingi (*Coprosma propinqua*), manuka (*Leptospermum scoparium*), kohuhu (*Pittosporum tenuifolium*), flax, toetoe and ribbonwood (*Plagianthus regius*), were planted to screen public access areas. In some areas, temporary screens of shade cloth were used to dissuade premature public access until plantings reached sufficient size. Screens also protect the new plants from the effects of over-grazing by pukeko and Canada geese.

REF: www.ccc.govt.nz/learning/educationforsustainability/naturalenvironment/traviswetland.aspx

View over the central pond planting projects after 5 years (photo taken 2005). Photo: John Skilton, Christchurch City Council

4 Monitoring

Monitoring the overall progress of your restoration project can be very rewarding and can help secure funding for further restoration works. Sound protocols as well as good documentation are important. Many of the vegetation monitoring techniques are not complicated, e.g., before and after photographs using photopoints and recording any natural establishment of new native plant species. More detailed methods on monitoring changes in overall wetland condition are outlined in Chapter 13 – Monitoring.

4.1 Wetland inventory and map

Using your wetland maps of vegetation types and/ or planting zones as outlined earlier in the chapter, indicate the location of monitoring sites e.g. permanent plots and photo points. Provide a description of the methods being used, the frequency of data collection, and how the data are to be presented. Lists of all plant and animal species should be compiled and updated at regular intervals. Indicate whether the species are native or introduced, and also the relative abundance of each, using a simple scale such as rare, occasional, common and abundant. A local botanical society may be able to help you do this.

4.2 Permanent plots

Establish permanent plots, selected as being representative of each main vegetation type, and monitor immediately before restoration and at intervals afterwards (yearly if rapid change is expected, less frequently for minor change). Aim for at least 3–5 replicate plots per vegetation type/ habitat as these will provide baseline information. Plot size will depend on wetland structure and number of permanent plots established; use several plots of at least 2 m × 2 m or 4 m × 4 m quadrats in low vegetation, and larger sizes, e.g., 5 m x 5 m or 10 m x 10 m for taller vegetation and/or fewer plots. In areas that have been completely transformed by weed removal, cleared land, new soil surface, etc., set up the plots immediately after planting.

The basic parameters to use are:

- Species composition
- Species cover
- Species height

For more detailed monitoring information on how to sample vegetation, soil and water parameters follow the Wetland Condition Handbook methodology and fill in the Handbook plot sheet (see weblink at the end of the chapter). Add any additional monitoring components specific to your wetland. Laboratory analysis can be quite costly so you may decide to analyse the soils and/ or foliage from just one plot per vegetation type/ planting zone to provide baseline information, and then only reanalyse at a later stage if you suspect a change has occurred.

4.3 Plant survival

Keep a database of what plant species, what size (e.g., PB 2), and how many were planted in each planting zone. Record any pertinent comments, e.g., planted during drought, water depth, health of plant, and method of weed control. At the end of each growing season determine plant survival based on parameters such as plant height and cover, health, impact of any browsing, e.g., by hares, or foraging, e.g., by pukeko, and whether the plant has produced flowers or seed (see the case study on Waiwhakere Natural Heritage Park in Chapter 13 – Monitoring). With larger restoration projects, instead of tracking individual plants, use permanent monitoring plots set up immediately following major planting events. This information will help you decide which plants are most suitable for specific habitats or environmental conditions present in your wetland, and how to modify planting programmes for the following season (e.g., by targeting certain weeds or pests). Share your knowledge with other wetland restoration groups to help minimise wasted effort and costs.

4.4 Photopoints

To visually record changes from precise locations throughout the wetland, set up a series of photopoints throughout the wetland. Use marker posts labelled with a number and an arrow to indicate camera direction so you can take the same view each time. Include photo points at the permanent plots by using one of the corner pegs to sit the camera on. Take the photographs at the same time each year, preferably mid-late summer, to eliminate seasonal changes.

Also note any regeneration, e.g., self seedings and spread of planted species. This is particularly important when new species planted in the wetland (indicate as 'planted' in the species list) begin to seed and spread by natural seedling recruitment.

A photopoint provides a very useful record of plant establishment. October 2006, Lake Serpentine, Waikato.
Photo: Monica Peters, NZ Landcare Trust.

Beverley Clarkson at the same site in March 2009. Lake Serpentine, Waikato. Photo: Monica Peters, NZ Landcare Trust.

5 References and further reading

Jacobson, R.L. 2006. *Restoring and managing native wetland and upland vegetation*. Minnesota Board of Soil and Water Resources, U.S.A.

Johnson, P.A. and Brooke, P.N. 1998. *Wetland plants in New Zealand*. DSIR, New Zealand.

Poole, A.L. and Adams, N.M. 1994. *Trees and shrubs of New Zealand*. Government Printer. Wellington, New Zealand.

Porteous, T. 1993. *Native forest restoration – a practical guide for landowners*. Queen Elizabeth the Second National Trust, Wellington, New Zealand.

Salmon, J.T. 1996. *The native trees of New Zealand*. Reed, New Zealand.

5.1 Useful websites

Wetland restoration templates

Waikato Regional Council Wetland Restoration Plan templates

www.waikatoregion.govt.nz/PageFiles/5799/Wetlandtemplate1.pdf

www.waikatoregion.govt.nz/PageFiles/5799/Wetlandtemplate2.pdf

Wetland restoration guides and factsheets (New Zealand)

Northland Regional Council

www.nrc.govt.nz/upload/2217/Wetland%20Restoration%20Guide%20(second%20edition%20Feb%2009).pdf

Auckland Regional Council

www.arc.govt.nz/albany/fms/main/Documents/Environment/Plants%20and%20animals/wetlandsfacts2.pdf

Waikato Regional Council

www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/

Hamilton City Council

www.gullyguide.co.nz/index.asp?pageID=2145821537

Bay of Plenty Wetlands Forum

www.doc.govt.nz/upload/documents/conservation/land-and-freshwater/wetlands/wetland-restoration-guide.pdf

Greater Wellington

www.gw.govt.nz/a-beginner-s-guide-to-wetland-restoration/

Department of Conservation Protecting Natural Areas Design Guide

www.doc.govt.nz/publications/getting-involved/volunteer-join-or-start-a-project/start-or-fund-a-project-/nature-heritage-fund/protecting-natural-areas-design-guide/

Wetland restoration guides (International)

USA Environmental Protection Agency

www.epa.gov/owow/wetlands/pdf/restdocfinal.pdf

Native and introduced plant identification resources

NZ Plant Conservation Network

www.nzpcn.org.nz

www.nzpcn.org.nz/flora_search.asp?scfSubmit=1&scfNative_Or_Exotic=2

NIWA aquatic quick guides for flora and fauna

www.niwa.co.nz/our-science/freshwater/tools/quickguides

Landcare Research

www.landcareresearch.co.nz/resources/identification/plants/weeds-key

Weedbusters

www.weedbusters.co.nz

Wetland planting guides
(use the guides relevant to your region)

Canterbury Region

www.ecan.govt.nz/advice/your-land/land-restoration/wetlands/Pages/wetland-planting-guide.aspx

Waikato Region

www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Wetland-planting-guide

Auckland Region

www.nznativeplants.co.nz/Articles/Wetland+Planting+Guide+for+the+Auckland+area.html

Botanical Societies

www.nzbotanicalsociety.org.nz/pages/links.html

Scientific journals

NZ Journal of Botany

www.tandfonline.com/loi/tnzb20

NZ Journal of Ecology

www.nzes.org.nz/nzje

Herbaria in New Zealand

www.nzherbaria.org.nz/herbaria.asp

Note that many of the resources above are available as hard copy from the respective organisations. There is also a CD containing all above hyperlinks at the back of this Handbook. If you are using the online version of the Handbook and having problems with the hyperlinks above, try copying and pasting the web address into your browser search bar.