



Riparian Planting

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11.1 Introduction

Planting is an important component of any waterway or wetland restoration project and its management. In particular, the riparian zone is closely related to the instream environment and thus the type and style of planting has an effect on this aquatic habitat.

A healthy riparian zone of sufficient width, in combination with a restored instream habitat, will provide a self-sustaining ecosystem that benefits the terrestrial and aquatic environments:

- Marginal vegetation (both directly overhanging vegetation and semi-aquatic vegetation) provides immediate cover for fish and invertebrates.
- Overhanging vegetation provides additional food sources for aquatic animals, from the plant material and from terrestrial invertebrates that fall off the plants into the water.
- Marginal vegetation can provide spawning sites for galaxiids (e.g. inanga or whitebait).
- Dense ground cover will reduce the amount of sediment contained in surface runoff entering streams.
- The roots of trees and other vegetation help to consolidate and stabilise banks.
- Exposed roots and woody debris in the water provide additional shelter and cover for fish, and additional habitat for invertebrates.
- Appropriate riparian vegetation will attract bird life, and ground cover and canopy trees may be used as roosting and nesting sites.
- Trees shade the stream, keeping water temperature cool and cutting out light to weeds.

The ecological goal for riparian planting is to create a sustainable and naturally functioning ecosystem, which requires a minimum of ongoing intervention and maintenance. Appropriate planting and habitat creation will also help attract invertebrates, fish, and birds back to the city.

A Biodiversity Strategy, Open Space Strategy, Natural Environment Strategy, and Citywide Planting Strategy for the Christchurch area are in preparation. These strategies will link City Plan objectives and policies with sustainable management practices for the city's natural resources (land, water, and air). Citywide planting is an important component of the overall strategy.

Riparian planting guidelines and checklists are set out below. For information on planting near estuaries refer to Partridge et al. (1999).

11.2 Planning, Design, and Preparation

The following sections (Sections 11.2.1 to 11.2.7) discuss the steps to take when planting alongside waterways and wetlands. For more comprehensive information, see Davis & Meurk (2001); a practical guide to protecting and restoring our natural heritage. For an overview of Christchurch's habitats, see Christchurch City Council (2000). Park (1995) gives an excellent account of the history and ecology of New Zealand's lowland ecosystems. There is information in this book that provides background and context applicable to ecological restoration in Christchurch and Canterbury.

Hill Waterways

Hill waterways require additional specific planting considerations, primarily due to the presence of erosion-prone loess soils. In addition to this chapter, refer to *Chapter 7.4.2.1: Planting for Bank and Channel Stabilisation*, for guidelines specific to hill waterways.

11.2.1 Site Planning

For site planning consider the following:

- Ensure good subdivisional planning and provision of generous development setbacks to avoid future conflict with adjoining owners due to loss of sun.
- Involve community residents and land owners in planning and site assessment (see *Part A, Chapter 4: Involving the Community*).
- Clearly define planting objectives; consider public access, ecological restoration, views, safety, drainage and cultural use of plantings. Organise resources (including labour) for site preparation, planting, and on-going maintenance.
- Observe the waterway or wetland during different seasons and assess opportunities for improvement (refer to *Part A, Chapter 3: Making Visions Real*).
- Characterise the stretch of waterway bank by referring to waterway and wetland profiles. Use Christchurch Ecosystem Maps (Lucas et al. 1995, Lucas et al. 1996a, 1996b, Lucas et al. 1997) and the Streamside Planting Guide (Christchurch City Council 1996) as the basis for selection and siting of indigenous plant species.
- Determine the minimum width needed for the riparian zone. Refer to Parkyn et al. (2000) and Quinn et al. (2001) for recent information regarding minimum riparian buffer widths.
- Plan dense planting of margins to minimise any competition from grasses. However, marginal vegetation should reflect future management.
- Plan to retain existing canopy trees and/or plant

canopy trees that will shade the waterbody. The shade provided (if over 70%) will help to reduce proliferation of algae and macrophytes, and lower water temperatures. Canopy trees are also required as nesting sites for some birds (Figure 11-1). See *Chapter 3.3: Birds and Their Habitat*, for details on particular vegetation preferred by avian fauna.

- If canopy trees are to be planted then consider the aspect of the stream and tree placement to provide maximum shading of the waterbody.
- In addition to canopy trees, consider planting cabbage trees (tī kōuka), which are significant plants in the Canterbury landscape. The cabbage tree is not only important in riparian plantings, but is significant to Maori for food, fibre, medicines, shelter, landscape markers, and for its spiritual qualities (Simpson 2000). A Ngai Tahu web site has recently been established specifically to explain the importance of tī kōuka to Maori (www.library.christchurch.org.nz/TiKoukaWhenua).



Figure 11-1: Canopy trees attract wetland birds like the pied cormorant (above left) and little cormorant (above right), that use them for roosting and nesting.

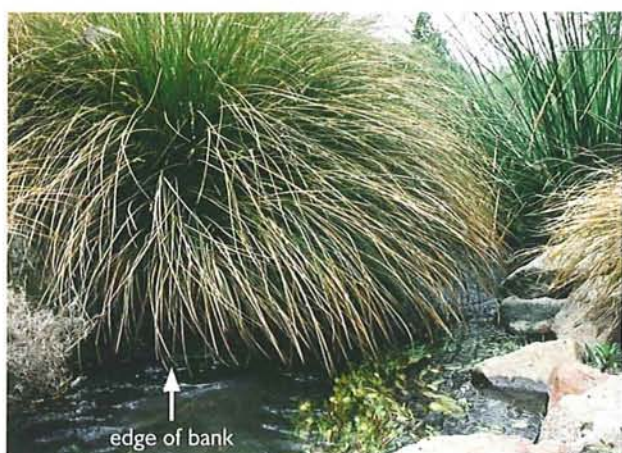


Figure 11-2: Planting sedges right at the edge of a vertical bank ensures a good overhang, which will be used by fish for cover. Sedges planted too far from the bank edge are less desirable as they will not create a good overhang.

Special Considerations for Marginal Planting

The following are recommendations for planting along stream margins. The choice of suitable marginal plants should always be discussed with a botanist.

- Ensure heterogeneity of vegetation by varying the height, density, and texture of the marginal plantings. Do not plant vegetation in a straight line along the stream margin.
- Select plants that are flexible and have low density foliage for planting along the stream margin. This is important for small tributary waterways, as planting within the waterway floodplain generally increases flow resistance, raising flood levels.
- Consider future management issues and alter the initial planting regime accordingly. Extensive plantings of large sedges and flaxes on small waterways is so generally not recommended, as they could eventually hide the stream from view and cause management problems. In small waterways (< 2 m wide) vigorous species such as raupo could eventually encroach across the entire channel and cause future drainage and management problems. Planting less invasive and smaller plant species will help to prevent these future management problems. Additionally, provide access areas for maintenance gangs or machinery to remove future problem plants.
- Keep all raupo planting in the appropriate habitat (e.g. margins of deeper water in large waterways or wetlands). It is essential to consult the Parks and Waterways Unit if raupo is to be used.
- For small tributary waterways large sedges can be planted above the waterline on more vertical banks. Large sedges planted on top of a bank will help to create an overhang that will provide cover for fish, without trapping sediment and rubbish. Plant these sedges as close to the bank's edge as possible, in order to create good overhangs (Figure 11-2). Small sedges such as *Eleocharis acuta* are good for planting on shallow bank margins.
- Leave some areas clear of high, dense vegetation. These can be used as access points for possible future maintenance and as areas for the public to view the stream.
- Carry out the planting of marginal vegetation in conjunction with the use of stable natural substrates such as rocks, logs, and stumps. Refer to *Chapter 9.5: Stream Bank Materials*.
- Planting waterway margins upstream of under capacity culverts, where velocities are already very low, will have little effect on flood levels: in many of Christchurch's smaller waterways the main

hydraulic controls are under-capacity culverts. Ensure flooding upstream is not an issue and culvert replacement is unlikely for at least 10 years.

- In tidal reaches provide spawning and rearing habitat for inanga (Figure 11-3). Spawning areas should have low-lying banks, which become submerged during high spring tides. Vegetation should consist of fairly long, thick growing grasses and rushes (or similar vegetation). This needs to be thick enough such that the roots remain damp, to prevent the eggs from becoming desiccated. Future maintenance should take into account the requirement to prevent maintenance during the spawning season (February–May).

11.2.2 Placing Plants in Ecological Zones

The Parks and Waterways Unit can provide information on both natives and exotics, including a list of non-invasive exotics for stream margin. Also refer to Johnson & Brooke (1989) for botanical descriptions of New Zealand wetland plants.

- Identify the different vegetation zones that are illustrated in the waterway and wetland profiles below (Figure 11-4). Consider slope, distance from the water, soil moisture, and water flows throughout the year.
- Compile a list of plant species for each zone identified along the banks.

Figure 11-3: Inanga spawn amongst bank vegetation that becomes inundated during the high spring tides. It is important to plant the right grasses in the area between the mean high water (MHW) level and the mean high water spring (MHWS) level to facilitate inanga spawning.

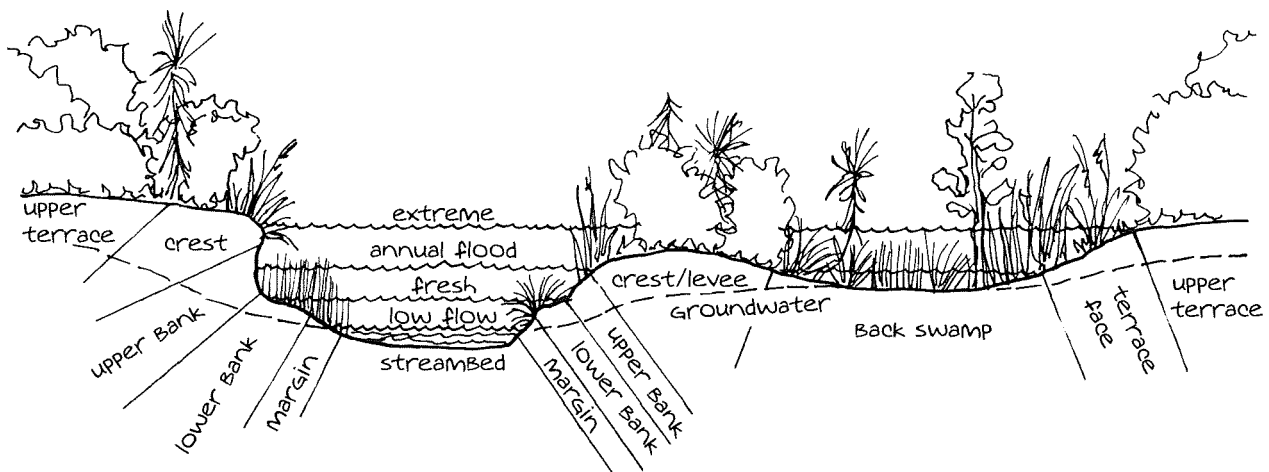
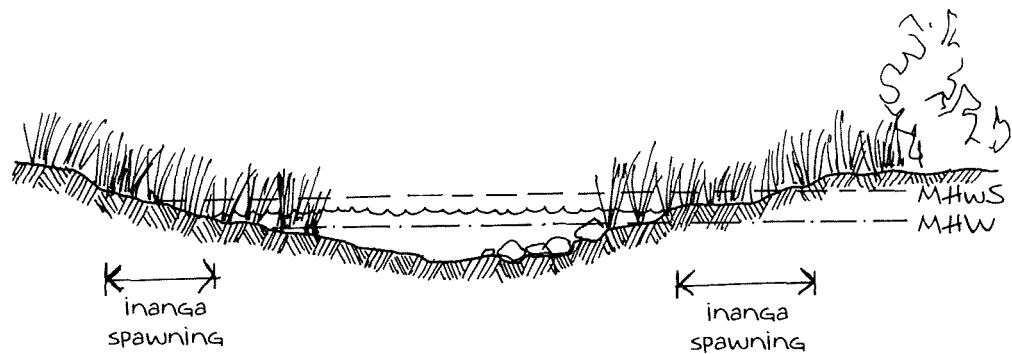
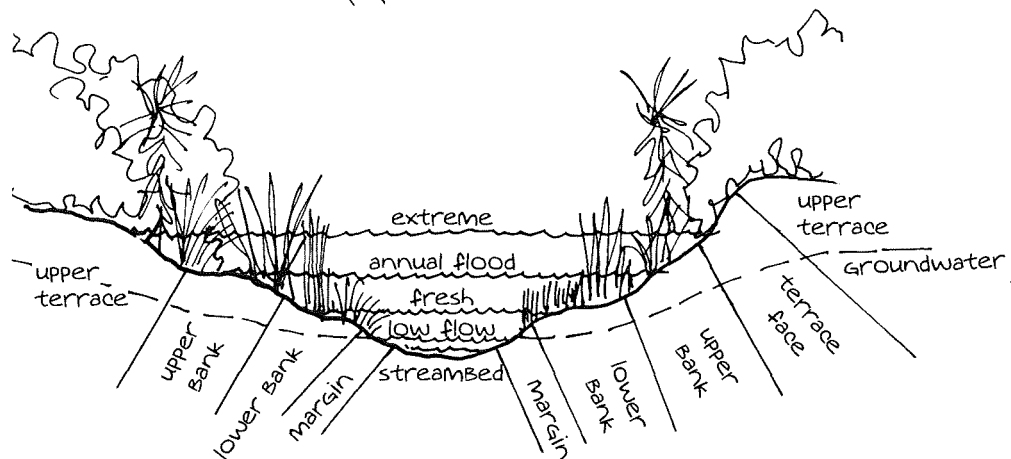


Figure 11-4: Examples of the planting profiles available for waterways with wetlands (above), and for waterways (right). These planting profiles, and information of the vegetation that should be planted in the specific areas can be found in the Streamside Planting brochure (Christchurch City Council 1996).



- Space plants according to the zone they belong in, and the size they grow to. Approximately one plant per square metre will be needed. Rushes, sedges, and ferns can be planted up to three per square metre.
- Plant the 'margin' and 'lower bank' species as close as possible to the water's edge. These and the 'backswamp' species should be planted in summer at low water levels, while plants further up the bank on free-draining soils should be planted in autumn or spring, with allowances made for frost tolerances. Additional issues for marginal planting has been covered in *Section 11.2.1: Site Planning (Special Considerations for Marginal Planting)*.
- Plant small trees and shrubs above the marginal and lower bank plants.
- On higher terraces and banks, plant tree species in mixed groups or as scattered individuals. The choice of canopy trees should also consider their ability to shade the stream: some trees will not provide sufficiently dense shade over the stream due to a light vegetation cover. This becomes particularly important if growth of undesirable aquatic weeds is an issue, as dense shade (> 70%) is needed to prevent or retard the growth of introduced problem species (Figure 11-5).
- All planting (exotic and native) should be carried out so that they are ecologically appropriate to the soil, moisture, and climatic conditions of the area. This policy avoids undue use of irrigation, fertiliser application, and herbicides.



Figure 11-5: Canopy trees that shade the waterbody by over 70% will prevent the growth of problem macrophyte species. Upper reaches of the Avon River/Ōtākāro.

11.2.3 Ordering Plants

- Order plants well in advance of planting.
- For native plants select a specialist nursery that can guarantee that seed stocks were obtained locally in Canterbury (i.e. ensure that material is sourced from local genetic stock).
- If plants are held before planting, make sure they are watered every day or the success rate will be lowered and resources wasted.

11.2.4 Planting Times

- Plant species in riparian margins during summer and plant in other areas during autumn (hardy plants) or spring (frost-tender plants).
- Some ground cover plants, slow-growing species, ferns, and frost-sensitive species should be planted after a year or two, once some initial cover has become established.

11.2.5 Preparing the Site

- Prepare the site by removing and/or controlling invasive weeds (e.g. convolvulus, ivy, periwinkle, pampas grass, grey willow, and alder).
- Remove rubble and waste material including compost heaps.
- If full restoration is not being undertaken, at a minimum remove unsightly structures.
- Competition between desirable species and tall grasses can limit plant survival. Clear a circle of about 0.5–1 m diameter around each planting position. This may need to be done when plants are set out.
- Rip the ground if heavily compacted and apply soil conditioner if topsoil is in poor condition.

11.2.6 Setting Out

- Set out plants in their correct zones and be aware of their potential size. Ensure that all plants have been well soaked, and that they do not sit in the sun for too long. Overcast days are better for planting than sunny days.
- For inexperienced planters especially, the plants should be set out by an expert in their appropriate zones prior to planting. Some of the near-margin zones vary greatly over a short distance, so precise placement is essential.

11.2.7 Planting, Fertiliser, and Mulch

The following are guidelines on planting methods, which should be followed for planting vegetation along waterways and wetlands.

- Prune off entangled roots, set the plant into a bed of soft, worked soil at the bottom of the hole, and repack crumbled soil around the root mass tightly to prevent air gaps.
- On dry, free draining or steep sites dig the plant into a deep hole, and set the plants in as deeply and as firmly as possible, so that a hollow is left around the stem to catch rain. On dry sites, a slow-release, complete fertiliser may be used, especially where the topsoil has been stripped. Water crystals may be placed at the bottom of the planting holes, and mulch applied.
- On wet sites however, potential ponding of water around the stems should be avoided. Plant in a shallower hole so that the top of the root mass and associated soil is at ground level, or even slightly mounded above it in saturated soils. Soil should not be overly compacted, nor should mulch be used unless it is capable of 'breathing'.
- Some species, if planted as small grades, may require temporary staking to protect them from wind damage. Stakes or markers may be necessary to identify plant locations on grassy sites.
- Water plants and the surrounding ground well after planting.
- Apply slow-release fertiliser to each plant and spread short-term fertiliser (e.g. super-phosphate) on the ground around the plants after planting and before mulching.
- On dry sites mulch with bark chips (up to a 10 cm depth), newspaper, woollen mats, or other degradable materials such as carpet underlay.
- On wet sites do not use mulch near the water's edge or anywhere near the water flow, as the mulch could be washed away and cause waterway blockages downstream.
- Where bank works adjacent to waterbodies have been undertaken, use a ground cover on the streamside banks to prevent undue addition of soil into the waterway (via surface erosion and runoff) while plants are becoming established. Some erosion protection mats include terramat and woolmat (Figure 11-6), which can also promote plant growth. Some weed mats can prevent weed growth and protect the soil (Figure 11-7).
- It may also be advisable to lightly consolidate the ground prior to planting to further reduce the chance of soil loss via surface runoff.



Figure 11-6: Woolmats (as above), or coconut fibre mats will protect the underlying soil, prevent runoff of soil into the waterway, and promote plant growth. Corsers Stream at time of planting (1996, top), and one year later (above).



Figure 11-7: Weed mats can prevent the growth of weeds and protect the otherwise exposed soil while plants are becoming established. Barkers Waterway on Anzac Drive.

11.3 Weeds/Plant Pests

Weed Legislation and Non-Statutory Groups

This is a brief summary of the legislation covering weed control, and also some of the groups involved. Much of it comes directly off the web sites referenced and links to web sites are included so that further detail can be researched if required.

"Weeds" are any organisms that are a risk to natural and/or physical resources or human health and may include plant species, sub-species, variants, cultivars, and genetically modified variants.

"Plant pests" are those that are subject to a pest management strategy or that have been listed as an unwanted organism.

The Christchurch City Council has a web site that has many of the weeds that occur in riparian and wetland sites (Figure 11-8), <http://www.ccc.govt.nz/Environment/Weeds>. Also refer to Christchurch City Council (2002).



Figure 11-8: Some riparian weeds found in Christchurch.

11.3.1 Weed Legislation

11.3.1.1 Biosecurity Act 1993

The purpose of the Biosecurity Act 1993 is to eradicate, or effectively manage, pests and unwanted organisms already in the country, or to stop them from entering. See the following web sites:

- <http://www.mfe.govt.nz/about/laws/bios.htm>
- <http://rangi.knowledge-basket.co.nz/gpacts/public/text/1993/an/095.html>

Unwanted Organisms Register

Web site: <http://www.maf.govt.nz/biosecurity/pests-diseases/registers-lists/unwanted-organisms/>

The register is required by the Biosecurity Act (1993). It is a register of organisms that have been determined as unwanted by Chief Technical Officers of a government department with biosecurity interests. It also contains organisms declined importation by the Environmental Risk Management Authority (ERMA NZ), and organisms listed in the second schedule of the Hazardous Substances and New Organisms Act 1996. The Ministry of Agriculture and Fisheries (MAF) Biosecurity Authority maintains the list.

There are several categories of unwanted organisms. See the web site above for further details.

In most cases unwanted organisms can't be sold, exhibited, distributed or propagated. In a few cases they may be subject to a small-scale management programme, carried out by the Regional Council. For a few species there is a requirement to report them to MAF.

Section 100 of the Biosecurity Act 1993

Web site: <http://www.maf.govt.nz/biosecurity/pests-diseases/small-scale-section-100.htm>

Section 100 of the Biosecurity Act enables a regional council to undertake small-scale management of unwanted organisms.

National Plant Accord

Web site: <http://www.maf.govt.nz/biosecurity/pests-diseases/plants/accord.htm>

The accord list is a subset of the unwanted organisms register. Parties to the accord are those regional councils and biosecurity departments (e.g. MAF Department of Conservation, DoC) that have put in writing that they want to be involved. This has the same status as a memorandum of understanding, and is not a binding contract.

The focus is to prevent the sale, distribution, or propagation of specified plant pests. There is no difference in legal status between a plant that is an unwanted organism and on the accord list, and one that is only on the unwanted organism list.

MAF Biosecurity Authority maintain the accord list.

National Pest Management Strategies

Currently there are none for plant pests, but they are a possibility under the Biosecurity Act.

Regional Pest Management Strategies (RPMS)

Web site: <http://www1.maf.govt.nz/cgi-bin/pms/pms.pl>

RPMS are prepared under the Biosecurity Act 1993, and most regions have one. MAF's web site maintains a list of which species are covered by each region's RPMS.

Canterbury has two RPMS. The Regional Pest Management Strategy (Environment Canterbury 1998) deals mainly with 'agricultural' plant pests and is shortly up for review. A discussion document (Environment Canterbury 2002a) is available at <http://www.ecan.govt.nz/Plans-Reports/pests-weeds.html>

The Regional Pest Management Strategy—Biodiversity Pests (Environment Canterbury 2002b) focuses on the organisms threatening Canterbury's biodiversity. This document is available at the web site address given above.

11.3.1.2 Hazardous Substances and New Organisms Act (HSNO)

The HSNO covers the deliberate introduction or development of new organisms, including genetically modified organisms. Available at <http://www.hsno.govt.nz/no.shtm>

Environmental Risk Management Authority (ERMA)

Web site: http://www.ermanz.govt.nz/Faq/q_21.htm

Administers the Hazardous Substances and New Organisms Act. Regulates deliberate importation, development or release of new organisms, including genetically modified organisms (GMOs).

11.3.2 Non-Statutory Groups

11.3.2.1 Biosecurity Council

Web site: <http://www.maf.govt.nz/biocouncil/index.htm>

The Biosecurity Council reports to the Minister for Biosecurity. The Biosecurity Council provides

a forum for the discussion of broad biosecurity policy issues, among the various departments with biosecurity responsibilities. They also provide a mechanism for establishing the need for, and/or priorities of programmes associated with managing exotic pests (or recent incursions).

Government departments involved include the Department of Conservation and the Ministries of Agriculture and Forestry; Health; Fisheries; Environment; Maori Development (Te Puni Kokiri); Research, Science and Technology; the Environmental Risk Management Authority; regional councils, primary production industry, environmental organisations; MAF Biosecurity Authority.

Biosecurity Strategy for NZ

A draft strategy is being written to provide a framework for all NZ. It is being co-ordinated by the Biosecurity Council, and is available at <http://www.biostrategy.govt.nz>

The purpose of the Biosecurity Strategy is to:

- set an overall direction for biosecurity
- identify areas of priority for the biosecurity programmes
- apply to the primary production (agriculture, horticulture, and forestry), public health, and indigenous terrestrial, marine, and freshwater environments
- provide guidance to all involved in biosecurity
- raise public awareness and understanding of biosecurity.

The purpose of the biosecurity strategy is to provide direction and guidance for all agencies involved in biosecurity and to obtain agreement on the priorities, goals, objectives, and measurable targets for New Zealand's biosecurity programmes.

The focus will be on the broad issues affecting biosecurity, rather than on debating specific programmes and currently topical issues.

11.3.2.2 Protect NZ

Web site: <http://www.protectnz.org.nz/>

Protect NZ aims to raise the awareness of biosecurity issues. The campaign is government funded and covers a wide range of government as well as non-government agencies and private sector organisations that deal with biosecurity issues.

11.3.2.3 NZ Biosecurity Institute (NZBI)

Web site: <http://www.biosecurity.org.nz/default.htm>

The mission is “to preserve and protect New Zealand’s natural resources from the adverse impacts of invasive pests” by:

- creating opportunities for the professional improvement of members on a local, national and international basis
- working to raise public awareness of the NZBI and biosecurity issues
- providing advice to policy makers and legislators.

11.3.2.4 Plant Protection Society

Web site: <http://www.hortnet.co.nz/publications/nzpps/index.htm>

This has more of an agricultural/horticultural focus than the NZ Biosecurity Institute and possibly a more technical approach. The Society’s objectives are to:

- Pool and exchange information on the biology of weeds, invertebrate and vertebrate pests, pathogens and beneficial organisms, and methods for modifying their effects.
- Federate with, affiliate with, or act in conjunction with similar Societies throughout the world, and to appoint representatives to any such Society.
- Establish branches and to provide for the appointment of local committees to deal with local matters or matters of general interest to the Society, which may require local attention.
- Do all such other lawful things as may be deemed incidental to conducive to the attainment of the above objects.

11.3.2.5 Invasive Species Specialist Group (ISSG)

Web site: <http://www.issg.org/>

The Invasive Species Specialist Group (ISSG) is part of the World Conservation Union (IUCN). The ISSG is a global group of 146 scientific and policy experts on invasive species from 41 countries. Membership is by invitation from the group chair, but everyone’s participation in the discussion on invasives is encouraged. Their headquarters are in Auckland.

They provide advice on threats from invasives and control or eradication methods to IUCN members, conservation practitioners, and policy-makers. The group’s activities focus primarily on invasive species that cause biodiversity loss, with particular attention to those that threaten oceanic islands. The group maintains a Global Invasive Species Database (see the web site above).

11.4 Establishment and On-going Maintenance

Maintenance is the most important part of the planting process, as it will determine the survival of plants and the security of the investment. A maintenance cycle must always be included when planning the project.

The Christchurch City Council has a waterway maintenance plant guide available (McCombs et al. 1999). Also refer to Collier et al. (1995) for detailed information about managing riparian zones. Finally, Davis & Meurk (2001) provides good detail on how to effectively maintain restoration and riparian planting areas.

For restoration sites on riparian margins, an operation and maintenance strategy must always be identified. It is important to know who is responsible for plant establishment at all times, and for each establishment phase. With planting, three plant establishment phases need to be considered:

- planting contract maintenance (usually 12 months duration)
- transitional maintenance while planting becomes established (usually year two-four after planting)
- ongoing maintenance from year five and beyond.

Unit maintenance costs are often around five to six times higher during year two, than for year five and beyond. Transitional maintenance is funded by the Christchurch City Council as a capital expense.

The following factors should be considered for proper establishment and maintenance of the riparian zone:

- Regularly check on plant health for several years after establishment.
- Remember that plants will survive and thrive if watered regularly in summer.
- Add more fertiliser to impoverished sites (this is rarely required).
- Weeding around plants is essential to avoid any competition and stress. Weeding should be carried out monthly, or more frequently if required.
- Nearer the water, careful hand or mechanical weed control is needed on an on-going basis, or until the plants have overtopped the grass. Prevent the addition of large quantities of removed plant material from entering the stream, especially when mechanical weed removal methods are used.
- Maintenance workers should be aware of the damage caused by ring barking of trees with ‘weed-eaters’, and thus endeavour to refrain from causing such damage. The principle of ‘more care

and less speed' must be adhered to.

- Where necessary irrigate during the first year, preferably at night or on a cloudy still day, in order to reduce water loss through evaporation.
- Plant species that provide a shrub or tree canopy cover to eventually shade out heavy grass and/or to provide frost protection.
- Place stakes beside smaller, less conspicuous species to ensure maintenance workers see young plants.
- Reassess plant suitability in light of plant loss, and replant areas where necessary. Transplant and thin crowded areas.
- Revisit the planted site on a regular basis over the initial years. For example, monitor any significant encroachment of plants into the waterway, and if necessary prepare for the removal of some plants.
- Specify maintenance requirements for areas where macrophytes (e.g. aquatic and semi-aquatic or marginal vegetation) have been actively planted, and/or have been identified as useful instream habitat. For example, in some restored areas, small, non-invasive native macrophytes may have been planted to increase habitat heterogeneity and biodiversity. Removal of these plants will need to be approved and monitored by Council. See *Chapter 9.8: Aquatic Vegetation*, for information about planting macrophyte communities.
- Ensure all maintenance work is in accordance with any health and safety issues.
- Ideally, teams with good motivation and plant identification skills should be developed, both within and outside the Council.

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