

4.2 MANAGING NATURAL FEATURES AND HERITAGE VALUES

Within the boundary of the dairy farm there may be areas of natural vegetation, landforms such as karst (limestone) or other formations, spectacular views or landscape values, or sites of archaeological or cultural significance.

Dairy farmers may be managing areas of land in which the wider public have an interest for recreational, cultural or natural heritage reasons. Managing these areas appropriately can create attractive features of interest that add value to the farm. Thoughtful management will promote the image of farmers as responsible stewards of the land, while minimising any impact on the farm operation.

4.2.1 Retaining and managing bush patches

Patches of bush are often only small remnants on dairy farms in the intensively developed areas of New Zealand; however they are worth retaining in spite of their small size, being representative of some of the now rarer types of lowland bush. Their values include the following:

- depending on distance to larger bush blocks, they may attract birds and other native wildlife and act as stepping stones through the landscape
- they provide an element of visual interest in a pastoral landscape and showcase New Zealand's natural heritage
- they can provide some shade and shelter for stock
- they often occur in gullies or sidlings where they protect soil and water
- farms on hillier sites or with a runoff block may also have larger bush blocks with more viable populations of native species. Even regenerating scrub has value as an excellent starting point for recreating natural vegetation cover.

Fencing remnants and bush blocks will protect the health of existing trees and promote regeneration and sustainability of the bush. As the forest floor vegetation thickens up, conditions become more suitable for more sensitive plant and insect life. Fencing is also advantageous to stop stock getting lost or stuck in gullies, in bush blocks or down tomo. Fencing prevents nutrient transfer from productive paddocks to stock camps in the bush.

While fencing is the most important protective action, most bush patches will also benefit from weed removal or replanting around the edges to reduce wind effects on regenerating seedlings (refer to 4.3 Plantings on dairy farms). Pest control is almost always beneficial (refer to 4.2.5 Enhancing natural areas with pest control). Dead and standing logs should not be removed as they provide habitat for insects and nesting holes for birds.

As many lowland dairy farms were developed on floodplains or drained wetland areas, the native trees may be a remnant of bush that existed under those previously wetter conditions (e.g. kahikatea swamp remnants). The bush health may have been impacted by soil drainage. Decisions on further drainage downstream of these areas should take this into account (refer to 4.2.2 Retaining and managing wetlands and open water).

4.2.2 Retaining and managing wetlands and open water

Wetlands are one of the natural habitat types that have been most severely reduced in extent by the development of productive land. As little as 5% of the original wetland area remains, and in some dairying areas (e.g. Hamilton basin) the figure is 1%.

Wetlands are the most productive type of habitat, providing an enormous food source to sustain unique ecosystems. They are home to rare native plants, birds and fish, and breeding grounds for many important game species. Most of New Zealand's wetland plants and animals are found nowhere else in the world – species like fernbirds, dabchicks and scaup, mudfish, giant jointed rush and many orchids.

Wetlands are also cultural treasures, featuring in the history and traditions of many hapu. Wetlands provided traditional fibres for weaving and clothing, building materials, medicinal plants and dyes, many of which are still used for these purposes. Wetland animals such as tuna (eels) are valued food sources.

While many people want to create open water or ponds, it is generally not a good idea to do so by excavating material out of existing wetlands. Areas of open water can be difficult to keep free of weed and algae in summer, and most native birds prefer swampy rushes and flax rather than deep, open water. If a pond is desired, choose a degraded wetland area that has been partially drained and is covered in weeds rather than native plants. The best pond habitat includes gently sloping, irregular shorelines that allow more vegetation to establish and birds to have easy access. If your project involves any sort of dam, check with your Regional Council before you start work.

Advice on game species habitat can be sought from Fish and Game NZ or Ducks Unlimited.

Wetlands also act as filters and sponges in the farm landscape with benefits for flood control and water quality. The dense vegetation slows water flow so that sediment settles, while the organic, peaty soils soak up water and release it slowly, maintaining summer water levels downstream. The soil-plant combination in a wetland is also the ideal site for processing nitrogen in farm run-off and seepage, releasing up to 90% of the N back to the air if sufficient retention time is achieved.

These benefits can arise from even small wet areas that may not have great visual impact. Swampy areas in paddocks, wet gully bottoms and seeps, small patches of raupo or wiwi rushes are in fact wetlands that have the values described above.

Best management of wet areas is relatively simple, and depends on retaining water levels and effective stock exclusion, especially during wetter months of the year. Allowing wetland vegetation to reestablish will maximise the habitat and nutrient processing benefits. It is also important to maintain unobstructed connections to other water bodies for fish.

4.2.2.1 Maintaining water levels

It is sometimes overlooked that water levels need to be maintained in wetlands to keep them healthy. Alteration of drainage conditions downstream can degrade upstream wetland areas. Care is also needed when raising water levels in a wetland; this should be done gradually over time to allow vegetation to adapt.

While draining wet areas may be an attractive option to obtain more grazing land, this needs to be considered in light of the benefits of retaining wetlands and the cost of achieving and then maintaining effective drainage, without which pasture quality will be poor. There may also be regulations about new drains or deepening existing drains near a wetland - check with your Regional Council.

Maintaining wet soils and therefore anaerobic conditions in a wetland is also likely to produce the most efficient denitrification process, resulting in more nitrogen being processed to the inert nitrogen gas (N₂) and a smaller proportion being released as the greenhouse gas nitrous oxide (N₂O).

4.2.2.2 Fencing and wetland vegetation establishment

Effective fencing will protect the wetland while also preventing stock from getting bogged in these wet areas. It may reduce animal health problems such as liver fluke.

Even temporary electric fencing in winter, with grazing in summer, will avoid compaction and pugging of the soils while wet and provide some of the filtering and sponging benefits for water quality and flood control. A permanent fence will do this more effectively and also allow wetland vegetation to re-establish for maximum habitat and nutrient stripping value, providing the carbon source for nitrogen removal processes. Visual appeal and habitat value can be enhanced further with planting of low-growing wetland species (refer to 4.3.1.2 Design for waterways and wetland plantings).

Wet patches with dense vegetation can also be used to treat runoff from tracks, races and crossings by diverting wash from these surfaces into patches of rough grass and wet soils, rather than straight into streams.

4.2.2.3 Connections to other waterways

A large number of native fish species, including whitebait, move between sea and freshwater and need an unobstructed pathway to complete their life cycle successfully. Many of these species live in wetlands for some or all of their lives.

Wetlands connected to streams at least 10 cm deep will be accessible to most native freshwater fish. However, long stretches of fast flowing or polluted water, flap gates, or overhanging culverts act as impassable barriers. For correct culvert design and placement, refer to 6.5.2 Culverts. Some juvenile fish are able to climb wet surfaces and a flexible corrugated pipe with water trickling through it can be used as a fish pass between wetland areas where there is an obstruction to their free passage.

4.2.3 Heritage, cultural sites and recreational use

Sites of historic or cultural significance may require specific management and provision for access.

Protecting archaeological sites from damage helps preserve irreplaceable heritage for future generations. Features of pre-European occupation such as pa sites, terraces and trenches, kumara pits and shell middens are susceptible to stock trampling and erosion, as are more recent features from military activity, gold mining and the like. Protective fencing may aid their preservation. However, tree roots and vines may be equally damaging to these sites, so light grazing with sheep is recommended where possible. Tree felling, tracking or other earthworks can also create major disruption of historic sites.

All archaeological sites are protected by the Historic Places Act 1993 from modification, damage or destruction. An archaeological site is defined as a place associated with pre-1900 human activity, where there may be evidence relating to the history of New Zealand. These sites should be avoided as possible if you are planning developments. If you are going to do work that may affect an archaeological site you must obtain an archaeological authority from the New Zealand Historic Places Trust before beginning work such as earthworks, subdivision, forestry, road construction, building, landscaping or fencing. For technical advice or assistance, contact the NZ Historic Places Trust on 0800 437 482. A list of consulting archaeologists is available from the NZ Archaeological Association website www.nzarchaeology.org. A resource consent may also be required from your District Council.

Urupa (burial areas) or other waahi tapu (sacred or special areas) should be treated with the utmost respect and the use of machinery and particularly earthworks avoided except under the guidance of local kaumatua (respected elders). If artefacts are unearthed, advice should be taken from kaumatua and technical assistance sought from an archaeologist, the Historic Places Trust or the Department of Conservation. If human remains are discovered, the correct process is to contact the Police, local iwi and the Historic Places Trust (all 3 parties are to be contacted).

In some cases, knowledge about these places will have been lost amongst current generations. In other cases, associations with significant sites may have continued, even over many changes of farm ownership. Issues can arise when management or access provision changes, as a new owner may be unaware of these associations.

Recreational or harvesting use is another case where people other than the landowner have an interest in a site on the farm and a desire for continued access. This may include angling, whitebaiting, eeling, collecting watercress or flax, harvesting medicinal plants, duck-shooting, and the use of walkways or swimming holes.

The ability to maintain and harvest traditional food sources is a critical cultural concern for Maori connected with particular localities, because correct hospitality (manaakitanga) to uphold the mana of the local people includes providing the customary local foods.

In all of these cases, desire for access to farm sites can be great source of concern for the farmer. Public access is an issue that gives rise to much debate as farmers fear that their property rights can be eroded and that access should be at the discretion of the farm owner. Issues with public access include concerns for personal, home and farm security, productivity impacts, privacy, fire risk, littering, animal welfare, health and safety risks and biosecurity risks.

Where land owners wish to promote access design of fencing to facilitate access can include stiles or lengths of insulator hose to allow people to traverse a fence without damaging it. Tree planting should also take into account recreational users' needs (e.g. clear areas near pools for fly-fishers).

Members of the public seeking access to any areas or sites on private land must ask permission from the land owner. Land owners should advise access applicants that they enter the private property at their own risk and point out any known hazards. On granted access, the public should respect the landowners wishes and have regard for gates, stock, littering, smoking and fires.

4.2.4 Legal protection and covenants

A covenant provides a means of legal protection against vegetation clearance, subdivision, earthworks or building for areas of native bush or other natural or heritage features on private land. It is registered on the land title and means current and future owners retain ownership and management of the area within the constraints of the covenant conditions, which are designed to protect the values of the area. The protection may apply in perpetuity or for a time specified in the covenant.

There is considerable scope for flexibility in the conditions of a covenant, such as provision for recreational infrastructure, tracks, and harvest of planted trees. This makes it an attractive option for farmers who want to be proactive about setting their own management conditions for a natural area on their farm, as there is minimal risk that protected areas will attract imposed conditions from external agencies at a later date.

Covenanted agencies usually cover the cost of surveying the block and contribute to the cost of fencing. They may also be able to provide advice about enhancing the site and help to source funding for pest control in the covenanted area.

Legal protection for an area can be achieved by:

- registering it with the Queen Elizabeth II National Trust under an Open Space Covenant
- in the case of Maori land, placing it under a kawenata (covenant) or creating a Maori reservation with Nga Whenua Rahui
- creating a conservation covenant with a District Council or the Department of Conservation (DOC) or a protected private land agreement with DOC
- applying for it to be registered with the Historic Places Trust.

A protected private land agreement involves the Department of Conservation and results in the area of natural or cultural value being set aside as 'protected private land' under the Reserves Act (1977). Such an agreement will provide a similar degree of protection as a covenant. The agreement is notified in the New Zealand Gazette and the notice is registered on the title. It is binding on subsequent owners unless otherwise agreed, whereas a 'management agreement' with DOC is usually renegotiated when land is sold.

The Historic Places Trust maintains a register of archaeological and heritage sites and can give advice on the best form of legal protection and management for these sites.

Other financial assistance and incentives are also available for heritage protection. The Nature Heritage Fund (administered by DOC) makes purchases of land with significant conservation value from landowners wishing to sell. Some District Councils also offer incentives to protect land such as extra subdivision rights (on-site or transferable) or rates relief. Contact your local council to enquire.

Assistance available for legal protection is summarised in Table 4.2-1.

TABLE 4.2-1

LAND PROTECTION FUNDING		
Funding Agency	Role	Contact Details
Department of Conservation	The leading Crown agency responsible for conservation. Can advise on how to identify, maintain and enhance existing values. Can give management advice on browsing and predator pests	Department of Conservation PO Box 10420, Wellington Phone 04 471 0726
Queen Elizabeth II National Trust	An independent organisation helping farmers protect their land. Jointly financed by government grants, donations, interest on investments and membership fees. Local District Councils process written applications. Restrictions are noted on the land title	Queen Elizabeth II National Trust PO Box 3341, Wellington Phone 04 472 6626
Historic Places Trust	The leading agency for the care and protection of historic places in New Zealand	The New Zealand Historic Places Trust PO Box 2629, Wellington Phone 04 472 4341
Forest Heritage Fund	Provides funding to protect indigenous forests on Māori and private land. Funding may be in the form of assistance with fencing, surveying, and legal costs	The Secretary Forest Heritage Fund PO Box 10 420, Wellington Phone 04 471 0726
Ngā Whenua Rāhui	Provides funds to help Māori owners identify and protect important lands	The Executive Officer Ngā Whenua Rāhui PO Box 10 420, Wellington Phone 04 471 0726

Note: Other organisations working with farmers to promote conservation on private land include Ducks Unlimited, Federated Farmers of New Zealand (Inc), Fish and Game Councils, Regional Councils, District Councils, The Royal Forest and Bird Protection Society, New Zealand Landcare Trust, Ministry of Agriculture and Fisheries, and the New Zealand Farm Forestry Association.

4.2.5 Enhancing natural areas with pest control

Control of a range of pests will greatly enhance natural areas such as bush blocks, riparian margins and wetlands.

Possums can damage young plants, weaken an established canopy and change the make-up of the forest through selective browsing of favoured species. They also eat birds' eggs and young chicks, and native insects, flowers and fruit. This impacts on the plants they feed on, the insect fauna, and the native birdlife. Possums can also consume significant quantities of pasture, constituting a direct cost to farmers.

Goats browsing on the forest floor can completely graze the understorey and ground cover and prevent regeneration.

Mice and particularly rats compete with birds for food (fruit and insects) and remove seed sources that could otherwise regenerate the forest. Rats also eat birds' eggs and chicks. Hedgehogs are an often-overlooked pest that will eat native insects and the eggs of ground-dwelling birds.

Stoats and cats are well-evolved predators that climb trees and kill birds on the nest. Predation from these species as well as rats and possums is the main cause of nest failure. Dogs are also a hazard to ground-dwelling birds such as kiwi. Regular control of predators in the breeding season (around September) will see more young birds fledge.

Magpies, while visible and audible, do not have as great an impact on native birds as the other species listed above.

A variety of animal pest control methods exist, which may suit different situations and preferences of the farmer. Bait stations for possums and rabbits are an effective low-labour method, and some toxins have the advantage of secondary kill of predators (when they eat poisoned prey). However, there is an ongoing cost involved in refilling with bait and there are licensing requirements for some poisons (refer to 7.1.7 Chemicals for animal pest control). Traps are a one-off cost but require ongoing labour to set and check for dead animals. Shooting can be effective in small areas but tends to be an ad-hoc approach to pest control.

Pest control should be well planned, since removing one pest or predator may promote prey-switching (e.g. cats switching from rats to birds) or pest explosions (e.g. removal of cats causing an explosion of rat numbers).

Timing of control is also important, for example greater control can be achieved by setting baits in winter when other food sources are limited, and more benefit can be had from controlling pests prior to the birds' breeding season. For these reasons, a late winter control effort can be most cost-effective.

Great care is needed when handling poisons or traps to ensure the safety of humans, stock and dogs, and to meet ethical standards for killing target species. SPCA- approved traps are now available. It is best to seek advice from your Regional Council, DOC or an experienced animal pest control contractor. There are also useful resources available such as "Restoring the Balance" (download from www.landcare.org.nz) or the New Zealand Farm Environment Award Trust's publication "Managing Natural Features on Farms" available from the Ministry of Agriculture and Fisheries website www.maf.govt.nz or from the Trust at info@nzfeatrust.org.nz

Most Regional Councils offer advice on controlling animal pests and have developed Pest Management Strategies that identify key plant and animal pests for the region. Regional Councils have also done intensive possum control for the Animal Health Board aimed at tuberculosis control, though this level of activity is now reducing. Some Regional Councils also carry out pest control funded by regional and special pest management rates to protect particular environmental values. They may also offer financial or material support to community members undertaking such control.

4.2.6 Top tips for enhancing natural features

- **Fence natural areas to avoid stock hazards and save time mustering, while protecting the natural values of the area and allowing regeneration of bush.**
- **Consider leaving battens off fences around bush blocks to minimise maintenance associated with tree and branch fall.**
- **Legal protection through a covenant will ensure the natural values of an area are retained while ownership remains with the farmer.**
- **Maintain water levels in wet areas and ensure connections to other water bodies are unimpeded for fish passage.**
- **Consider wider public interest in sites on the farm and how access can be maintained without disrupting farm operations or creating undue risk.**
- **Carry out pest control to enhance wildlife in bush blocks, especially in the lead-up to the spring bird breeding season. Use low-maintenance bait stations or low-cost traps – seek competent advice on the best methods for your situation.**

4.3 PLANTINGS ON DAIRY FARMS

Plantings may be desirable on a dairy farm for a number of reasons, the main ones being:

- more shade and shelter for stock
- more diverse native flora and fauna in the farm landscape
- enhanced waterways and wetland habitat
- erosion control
- timber production
- reduce evaporation and increase irrigation efficiency.

Further benefits may include firewood from woodlots or products such as manuka honey, enhanced recreational opportunities, and greater visual appeal and property value. Permanent plantings also form a carbon sink, removing the greenhouse gas carbon dioxide from the atmosphere.

Steps to take in successful planting include the following:

1. Clearly defining what the tree planting is for: e.g. riparian strip, erosion control, shelter, timber or habitat planting.
2. Selecting species that will satisfy the purpose and do well at the site, taking the whole farm system into account.
3. Sourcing trees early to ensure a good supply of suitable seedlings at the right stage of growth, including locally sourced plants if using natives.
4. Protecting plantings from stock, usually by fencing off the area.
5. Clearing any weeds in the fenced areas well in advance of planting natives, which are sensitive to herbicides.
6. Preparing the plants and planting out, selecting the right spot for each plant. Mulching and staking should be considered.
7. Carrying out maintenance, including weed and pest control and pruning.

4.3.1 Design for different purposes and sites

The purpose of the planting and the local site conditions will determine the appropriate species and planting design. While there is scope for personal preference, it is wise to seek advice from others who have done plantings in the locality as to what has been most successful. Neighbouring areas of native bush will also provide guidance as to what grows well where you are – the species around the edges will give the best idea of what will establish on a bare site. It may be wise to plant a small area with a range of hardy coloniser species in the first year and observe what grows best.

Certain plants should be avoided. These include exotic species that may become environmental pests. As a plant's potential to be invasive depends on local conditions, check with your Regional Council for a list of pest plants. Other plants are poisonous to stock or can cause abortions. For example, cypress species including *macrocarpa* and *lusitanica* may induce abortions in cattle and the native species *ngaio* and *poroporo* have been reported as poisonous to young stock.

Siting of plantings and fencelines will often be determined by practicalities and farming considerations. However, where a natural landscape effect is desired, it is wise to follow a contour and avoid straight lines, and to plant naturally-occurring, rather than garden variety plants (e.g. with coloured foliage). Diverse plantings will give greater biodiversity benefits and a more natural landscape effect than a single species.

Consider the following when planning where to plant:

- site conditions such as wind, frost, aspect, drainage and also stock requirements for shade or shelter
- areas with problem weeds, steep contour, stock danger or unproductive grazing that might be better used for trees. Consider also any weeds that might threaten a planting
- any flood channels that need to be kept clear of obstructions
- desirable views to protect or enhance, and undesirable views to screen
- existing plantings, bush areas or riparian strips to add to or connect up
- Opportunities where fencing of areas can contribute to farm paddock subdivision.

4.3.1.1 Design for bush plantings

A wide variety of species can be found in these areas, so look at naturally-occurring vegetation to see what is common locally.

Planting into open, exposed sites may require a 'nurse crop' of hardy, coloniser species to be established first, with a later planting of mature canopy species amongst it, which will gradually overtop the nurse crop. Once a thickly planted nurse crop is established (i.e. the pioneer species are at least 1 m tall), other species can be interplanted at a rate of 50-100 canopy trees for every 1000 hardy plants, or a spacing of about 6 m apart. If you plan this in advance, gaps can be left in the nurse crop for planting later. Otherwise, some thinning may be required to create gaps in the nurse crop cover for the larger trees.

Gorse can also be used as a nurse crop and may be simply fenced and left for natives to gradually take over (where a suitable seed source is nearby), or gaps or lines can be cut in the gorse to provide planting sites for native trees.

Typical coloniser species that could be used in a nurse crop cover are kanuka (drier sites) or manuka (wetter sites), cabbage trees, *Pittosporum*, *Olearia*, *Coprosma* and *Pseudopanax* species and toetoe (native *Cortaderia*, not to be confused with introduced *Cortaderia* species or pampas, which is a weed).

For colder areas, frost tolerance is important. The colonisers listed above are frost tolerant, while others like wineberry, fuchsia and mahoe may suffer some frost-pruning but then recover.

If plants with a range of flowering and fruiting seasons are used, these natural areas are more likely to attract birds and native insects.

4.3.1.2 Design for waterways and wetland plantings

An ideal riparian planting includes low overhanging plants along the banks (such as sedges and toetoe), to enhance bank stability and provide cover for stream life. A range of tree species can then be set back from the bank, ideally leaving a grass strip on the paddock side of the riparian area for filtering purposes. Nitrogen-fixing species such as alders should be avoided, as nitrogen is undesirable near waterways. Species that create a dense litter layer (such as mahoe) will help trap and filter run-off. If only one bank is to be planted, planting the northern side will provide maximum shade to the stream and less to the paddock.

Low, dense, and stalky vegetation is ideal for wetlands as it helps to slow runoff and lengthen the time water is retained in the wetland, while providing a carbon source for bacteria that strip nitrogen. Suitable plants include locally-occurring species of native sedge, raupo, rush and flax, all of which can be split from existing plants and the sections planted out. By enquiring with local weavers about desirable flax varieties, an asset for harvest can be also created to provide for cultural use.

Large tree planting is not always advisable near wetlands as trees can dry the site and shade out low vegetation that assists in filtering and nutrient stripping. Trees like manuka or karamu can be planted further back, where soils are moist but not saturated, reserving lower growing wetland plants for the waterlogged soils.

Tree planting around effluent treatment ponds is also not recommended as shading can reduce the effectiveness of effluent treatment. Low shrubs or toetoe can be used.

Riparian planting design should consider where unimpeded flood passage is needed – small sedges that lie down flat in a flood may be the most appropriate on these stretches.

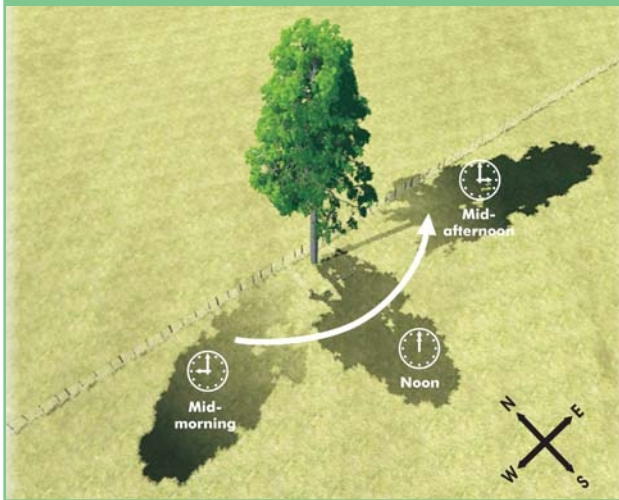
4.3.1.3 Design for shade and shelter

Priority areas for shade are those where stock spend a lot of time e.g. yards and pads. Many farmers prefer deciduous trees since they only provide shade when it is needed in summer and do not shade pasture and preventing tracks from drying out in winter. Fast growing trees such as poplars are a common choice, although possums may damage some varieties where they are present in high numbers. For considerations for planting around pads refer to 6.6.1 Planning a stand-off or feed pad.

High pruning of paddock shade trees is recommended so that the shady area moves around with the sun to prevent stock camping in one spot (refer to Figure 4.3-1).

FIGURE 4.3-1

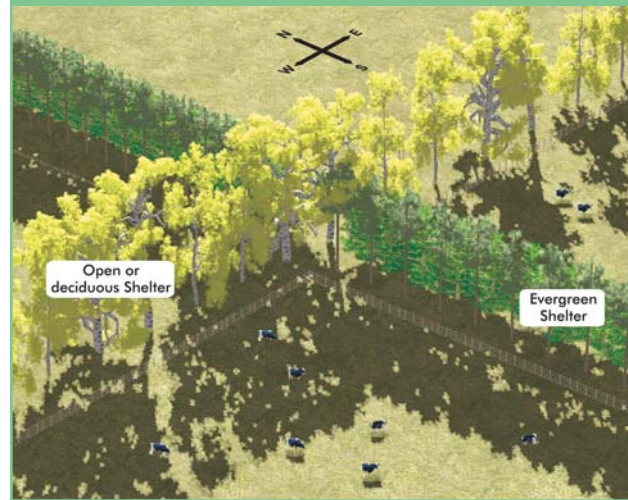
A TALL TREE WITH PRUNED TRUNK PROVIDES SHADE THAT MOVES AROUND



Source: Environment Waikato

FIGURE 4.3-2

DECIDUOUS SHELTER CAN BE USED TO REDUCE PASTURE SHADING ON THE SOUTH SIDE OF A BELT THAT RUNS IN A WEST-EAST DIRECTION



Source: Environment Waikato

Shelter is usually provided by planting belts of trees, though clumps or riparian strips can also be effective. Species should be selected that grow tall and cope with open windy sites, while tolerating pruning. Ideally shelter should be porous, so that wind is filtered rather than blocked, as a solid shelter can create funnelling effects or turbulent air further down-wind.

Shelter is usually oriented to be effective against prevailing winds. If planted on a west-east plane, deciduous trees may be preferable, while evergreen natives can be used on a north-south planting without creating undue shading of pasture (refer to Figure 4.3-2).

Single row shelterbelts rarely provide good timber, since open conditions promote branching. However, they can be used as a firewood resource, and often create refuges or corridors for wildlife.

4.3.1.4 Design for erosion control

For bare eroding sites, the best protection comes from achieving a closed canopy of trees in the shortest possible time. This means a fence around a dense planting will be more advantageous than a spaced planting for an already eroded site. Spaced poplar plantings where grazing can be maintained below the planting are useful for sites that are not yet eroding but are at risk of slipping or slumping.

In spaced plantings, the interlocking roots of the trees form dense nets 5 to 6 m wide. As long as trees are no more than 12 m apart, unstable subsoil is bound by the roots (like reinforcing mesh in concrete).

Trees growing on open, stabilised ground cause a reduction in relative pasture growth of up to 20% for individual deciduous broadleaved trees and 40% for the collective effect of space-planted trees. This is due to shading and competition for water and nutrients, and depends on the layout and shape of the planted area. However, farmers surveyed in studies have reported no drop in production from space-planted paddocks, which may be because pasture production is impacted at a time when there is enough feed anyway (spring-early summer), or because animal stress is reduced, giving production gains. Also, the probability of large-scale slips or slumping in the absence of tree planting and the consequent severe loss of production means that overall there may be no net loss from planting of spaced trees on unstable 'at risk' ground.

With close planting, the dense root network and continuous canopy cover afford maximum protection to the eroding site. Although the land is lost to grazing, the slip or gully is stabilised, protecting surrounding grazing land and farm infrastructure, and greatly reducing sediment input to waterways.

Tree planting beside streams and rivers can reduce bank erosion by more than 50% relative to unplanted banks. Along small waterways this can be undertaken as 'pair planting' where spaced trees are planted on opposite banks, close enough for roots to interlock beneath and along the channel. Non-suckering, deep rooting tree species will stabilise steep banks and undercuts without becoming weeds.

Crack willow invades waterways and is easily spread. Grey willow has fine seeds that disperse quickly and can also become a weed. Silver poplars should be avoided as they sucker, split, fall into waterways and can spread downstream. Non-suckering and sterile willows and poplars are available that are fast growing and deep rooted – contact your Regional Council for advice. Native species with rapid root growth include ribbonwood (*Betulinus regius*), cabbage trees and lemonwood (*Pittosporum eugenioides*).

Where banks are severely eroding, some type of structural intervention may be required for stabilisation (refer to 6.7.3 Streambank engineering and in-stream works). However establishing vegetation is usually a preferable sustainable option. On eroding bends, a 'sacrifice zone' may need to be left, with trees planted behind this in an effort to prevent future bank erosion. Bank reshaping is also sometimes beneficial prior to planting to allow vegetation to establish and reduce bank scour, while increasing channel capacity. Check with your Regional Council before undertaking any river bank work to see if you need a consent, and if you are in a drainage scheme seek advice from the drainage authority.

4.3.1.5 Design for timber

Timber plantings may be fast-growing exotics or longer-rotation natives. For smaller areas, high value timbers may be preferable to pines, especially where the site is some distance from a port or processing facility. The choice of native or specialty timbers may also enhance habitat and landscape diversity. Relatively high growth rates and good timber quality can be achieved for native timbers such as totara and kauri. However, pines have the benefits of assured market outlets and contractor experience with planting and silviculture as well as a low cost of establishment.

If a woodlot of specialty exotic or native timber species is desired, growth rates and site preferences are an important consideration. The best growth rates often occur on sheltered sites where soils are deep, moist and fertile, but for farmers this preference must be weighed up with retaining grazing land. While natural occurrence of a species can be an indication of site preference, some tree species may actually do better on sites where they are not naturally dominant. For example kauri are often seen on drier ridges where they out-compete other species that will not tolerate dry conditions, but the fastest growing kauri are found on lower hill slopes with better soils. Avoid planting timber species on unstable gully walls or floors as slips may carry away the young timber trees, or erosion may start again following harvesting. These areas are better suited to a cover of hardy, fast-growing natives.

Where the site for a timber plantation is exposed to wind or severe frost, it may be necessary to establish a 'nurse crop' of pioneer species such as manuka or kanuka, and then plant other species into it.

Even where a nurse crop is not established prior to planting the timber species, fast growing and cheaper shrubby species can be used to 'bulk out' a planting of timber trees. A mixed planting like this will:

- help to achieve rapid canopy closure and reduce weed growth
- encourage the timber trees to grow up straight and fast with minimal side branching as they compete for light.

Wherever larger trees are mixed with others either by planting together or by inter-planting at a later date, regular inspection is required to ensure light levels remain adequate for the slower growing but high value timber species. Pruning is also required to encourage the correct growth form (refer to 4.3.6.3 Pruning).

4.3.2 Sourcing trees

The following options are available to obtain trees for farm plantings:

- natural regeneration. This is a low cost option if local seed sources exist nearby, but weed control may be required for some time. If a cover of a pioneer species like kanuka or manuka establishes naturally, other species can be inter-planted later
- splitting existing plants. This is a low-cost and effective option for flax and many other wetland plants
- growing your own from seed or cutting. A small-scale nursery can be established and plants grown from seed. Poplar poles can be cut from existing trees and planted directly or rooted in the ground before transferring to the planting site. Small nursery stock can also be bought and potted up to grow on at home
- direct seeding. This is possible for species like flax, cabbage trees and Pittosporum. The key issues are seed availability and quality, and control of weeds post-sowing. A useful technique is to lay manuka brush with seed capsules down on bare ground in a fenced area, allowing the seedlings to come up underneath

- nursery-grown plants. Exotic trees can be purchased bare-rooted or as poles, but native trees are usually bought in bags or root trainers. Root trainer plants have smaller root systems so require more attention post-planting. Healthy, bushy plants with well-formed root systems that are 50-70 cm high are preferable for a low maintenance planting
- donated plants. Many community groups grow trees for planting on farms.

When obtaining plants, ecosourcing is a good principle to follow. This means obtaining plant material sourced from naturally-occurring wild populations close to the site where you are planting. This is important to preserve the distinctive natural character of your locality. Also, because local seed and plants have evolved for the climate and soils of your area, they may be more likely to survive and flourish than outside plant stock. Some native trees (e.g. karo and pohutukawa) are commonly planted outside the area in which they naturally occur, but to retain the uniqueness of each landscape, only locally occurring species should be used. Consult a local expert or check species lists from nearby reserves.

The choice of plant material will depend on what is available and the cost. While initial cost is higher for a larger plant, a tall grade of tree (50 cm-1m high) spaced 1-1.5 m apart will out-compete weeds faster and minimise the need for weed control later.

4.3.3 Protection from stock

Protection from stock is important for all trees at planting, and for most trees ongoing stock exclusion is required.

Stock protection options on dairy farms include:

- an electric fence – suitable where there is a consistent power source and the fence will be checked regularly when stock are grazing alongside
- non-electric permanent fencing. Some dairy farmers recommend using no battens around bush blocks to reduce the maintenance cost of fallen trees and branches
- the use of an electric outrigger to keep stock off the fence and prolong its life, or to go around single shade trees near a fenceline
- tree guards purchased or built for single shade trees
- the use of plastic sleeves for exotics (e.g. poplar poles), eventual grazing around the tree. However stock must be excluded from the site at planting, and vigilance is required when the sleeves are removed or start to fall off, as stock may quickly ringbark even quite mature trees.

If the bush patch is small, open underneath and/or exposed to wind, it is advantageous to place the fence five or more metres from the bush edge and plant up a buffer zone of hardy shrubs (refer to 4.3 Planting on dairy farms). This helps to seal the bush and reduce the 'edge effects' of wind and light intrusion into the main bush block. If no buffer is to be planted, fencing close to the bush margin will minimise weed invasion.

Stock will generally take shelter alongside the fenced bush, but some farmers choose to leave isolated trees outside the fence as additional paddock shade. However, stock pressure on root systems will generally have a detrimental effect on native trees.

If the planting is on a boundary, it is wise to speak to neighbours about the importance of keeping their stock out of the planted area and the sensitivity of plantings to herbicides.

4.3.4 Weed and pest control prior to planting

Serious weeds that will not be easily out-competed by your planted species must be controlled before planting (e.g. blackberry and willow). Repeated treatment may be needed before the site can be planted. Native trees are sensitive to many herbicides, so if residual chemicals are used, adequate time must be left before planting.

Animal pests can also seriously affect plantings and if these are present in significant numbers, control should be undertaken before planting.

4.3.4.1 Controlling weeds on planting sites

Unwanted willows and poplars should be felled in dry conditions when the wood will not re-sprout, and the stumps painted with herbicide within 20 minutes of cutting. Avoid putting off-cuts anywhere near water - all sticks and branches should be stacked and burnt or removed off-site. The site should be left for another year so that any re-growth can be dealt with prior to planting. Poisoning of standing trees is another option, e.g. by drilling a hole in the trunk and filling this with a small quantity of herbicide.

Where invasive weeds have been cleared, a high density planting is recommended to establish a canopy of desirable species as soon as possible. Mulching may also help to control reinvasion of some species.

Once the site is free of woody weeds, the most common approach is then to either spot-spray with glyphosate a 1-m square for each tree at least a week before planting (refer to Figure 4.3-3), or to blanket spray the whole area to be planted. Where the labour is available, hand clearing a 1-m square with a spade is another option.

Some farmers have had success with an alternative approach to site preparation. This involves planting straight into a ryegrass/clover sward, which helps to exclude other weeds and disguises young trees from rabbits or hares while providing a degree of shelter and moisture retention for the seedlings. Experimentation on your own site will help determine the best strategy for local conditions.

4.3.4.2 Controlling animal pests

Animal pest control may be beneficial before planting. The pests most likely to damage newly planted trees are rabbits and hares, which can chew or bite through the stems, and goats, which will browse trees. Seek advice from your Regional Council for the most up-to-date control methods for rabbits and hares, which can include shooting, fumigants, or baits. Tree protectors or spray-on repellants can also be used to discourage these animals. Feral goats can only be controlled by shooting.

Pukeko are a native species and therefore protected, but they will often pull up young trees, which will then need to be replanted. Some farmers have excluded pukeko with three electric wires set at 10 cm, 30 cm and 50 cm above the ground. As pukeko are considered a game bird they can be shot during some periods during the year with a license from Fish & Game. Check with your local Fish & Game Council for appropriate advice.

4.3.5 Planting

Before planting, consider the following:

- the best timing for local conditions
- planting density
- plant condition
- layout at the planting site
- mulching
- staking.

A typical dairy farm will rarely require soil preparation to successfully establish trees. On severely compacted soils, ripping may have a beneficial effect. Fertiliser is not normally needed, as soil fertility is sufficient for most tree species.

On dry sites an irrigation line may assist the establishment of shelterbelts that are exposed to strong wind.

FIGURE 4.3-3

SPOT SPRAYED PLANTING PATCHES IN PREPARATION FOR PLANTING



Source: Environment Waikato

4.3.5.1 When to plant

Generally, the wetter winter months are best for planting (between April and September), but local seasonal conditions and farm peak labour demands should be taken into account. In deciding on timing, consider the following principles:

- Autumn planting in dry areas helps seedlings establish before soils dry out
- waiting until spring in cold areas can avoid the worst frosts. However, in some sites frost-hardy species that have been well hardened off can be planted as soon as the soil is moist enough in autumn to gradually acclimatise to frost and to get good establishment before summer. This approach may be especially appropriate in sites with free-draining soils that dry out quickly in summer
- summer plantings in wetlands allow plants to establish while water levels are lower, as long as there is adequate soil moisture to sustain them until winter
- bare-rooted plants or poles should be planted out in winter during dormancy.

4.3.5.2 Planting density

For patches, riparian areas and timberlots, a major choice is around density and size of plants:

- use smaller, cheaper plants spaced further apart if you are prepared to put time into looking after them
- use larger, more expensive plants at close spacings (1-2 m apart) to achieve good cover quickly and avoid weed invasion (refer to Figure 4.3-4). This is critical if you will have minimum time for maintenance, especially over the busy spring period when weed growth is fastest and farm labour is often stretched.

Lower density plantings (up to 5 m apart) will allow more rank grass and weed growth around trees, which can be beneficial for the filtering function of riparian margins. It may also be the most appropriate option where access and space is required by anglers.

High density plantings with rapid canopy closure gives more effective erosion protection.

For timber, a lower density planting will need less thinning to reach final stocking but will require more tending to ensure good tree form.

FIGURE 4.3-4

THIS WELL-MULCHED, CLOSELY PLANTED AREA WITH LARGE SEEDLINGS WILL QUICKLY CLOSE OVER AND EXCLUDE WEEDS



LIKE THIS AREA OF 3 YEAR OLD PLANTS



Source: Greater Wellington Regional Council

4.3.5.3 Plant condition

Before accepting delivery, check plants for root distortions. Any roots circling around the container should be cut as these will hinder growth.

Plants in containers should be placed outside to harden off and adapt to local conditions, preferably for several weeks before planting.

Water plants well before transporting them to the planting site if there is no water on-site.

Bare rooted plants or poles should be kept moist and planted as soon as possible.

4.3.5.4 Layout at the planting site

At planting time, it is useful to have a knowledgeable person set out the plants at required distances and have the planters follow behind. Group plants of certain species together in a favourable 'zone' rather than randomly scattering all the plants. If a mixture of larger trees and smaller trees are being planted, set out the larger trees first at their final spacing (4-6 m apart), and then in-fill with smaller shrubby species. Avoid straight lines.

For wetlands or riparian areas, set plants out in zones according to their water tolerance. Place reeds and rushes on the water edge, flax and cabbage trees next, and then small trees like manuka on the drier soil towards the paddock side.

4.3.5.5 Mulching

Mulching is a good weed control option if you can get sufficient quantities of mulching materials to the site and you have labour available to spread mulch as well as plant. It involves placing 1 square metre of mulching material around the plant, keeping stems clear to avoid rotting. In addition to providing effective weed control for some months, mulching helps retain moisture around the tree roots.

Any organic material is suitable, e.g. newspaper, a 1-m square of wool carpet with a slit cut in it for the tree, or straw, old silage or calf shed bedding piled up to a depth of 10-15 cm. Dry materials such as newspaper should be weighted with clods of earth. Commercial weed mat squares are also available.

4.3.5.6 Staking

Staking trees makes them much easier to find in spring, especially if stakes have their ends marked with dazzle paint. It can also help taller trees survive in windy sites.

4.3.6 Maintenance

Aside from maintaining stock exclusion, weed control is likely to be the most important aspect of ongoing management. Animal pests should also be controlled in new plantings and existing blocks to protect native plants and animals (refer to 4.2.5 Enhancing natural areas with pest control). Trees planted for erosion control, timber, shade or shelter will usually require some silviculture to maintain the best form for that function.

4.3.6.1 Weed control in retired or planted areas

Weed control is often the greatest concern for farmers considering fencing out areas of the farm. Weed or grass growth is also the most common reason for failed plantings. A weed problem is most likely to arise where trees are planted too small or too far apart, or are not tended by releasing (freeing the young tree from weeds). Weed control is less of a problem for dense plantings, and where mulch is used, but vigilance is still required to ensure weeds do not out-compete the planted trees.

Weed growth should be checked during spring and summer to ensure weeds are not overtopping and smothering the planting. Plants may need releasing several times in the first year and monitoring for the first 3-4 years until a good height is achieved.

Plants can be hand-released or a grass-specific spray can be used, or glyphosate can be sprayed carefully, avoiding any contact with native plants (e.g. use a coarse jet at low pressure, and protect plants with a spray shield.)

Weeds to watch include the following:

- any regrowth of previously cleared willow, pampas, gorse or blackberry – control these early with a grubber or careful application of chemicals to avoid a major infestation. Note that native *Cortaderia* (toetoe) is related to the imported pampas *Cortaderia* species and the two are easily confused. If in doubt, seek advice (e.g. from your Regional Council)
- shade-tolerant weeds establishing under the plantings, such as ivy, wild ginger or wandering willie (*Tradescantia*). Unlike other weeds, these will persist after canopy closure
- climbers that can smother native plants, either when trees are small (e.g. *Convolvulus*) or with established bush (e.g. old man's beard). Climbing plants should be dragged off trees before pulling out or spraying to avoid damaging the natives. Vines can be cut near the base and both ends painted or dipped in herbicide

- weeds of environmental significance vary between regions and what is a serious pest in one region may be a benign garden plant in another. Seek advice from your Regional Council about the control status of plant pest species.

4.3.6.2 Animal pest control

As your plantings mature, they will benefit from action to reduce browsing from possums and invasion of predators such as cats, or mustelids (weasels, ferrets and stoats). Refer to 4.2.5 Enhancing natural areas with pest control.

4.3.6.3 Pruning

Regenerating natives planted in blocks require little pruning intervention, unless some of the more vigorous species are outcompeting desired slower growing species.

However, trees planted for erosion control, timber, shelter or shade will usually need some attention to form:

- erosion control species will benefit from pruning to maintain a good central leader, and where there are spaced plantings of poplars for erosion control, side branch removal will create less shading of pasture below
- timber trees also require attention from an early age to remove multiple leaders, and as time goes on, pruning is needed to remove bottom branches. Forest stands can be certified to document the silviculture that has been done on the trees. This process has a cost but will raise the value of the stand and may therefore be a good investment for larger blocks
- shade trees should be high pruned, so that the shady area moves around during the day and stock camping is minimised
- shelterbelts can be kept porous by thinning and pruning, and branches that threaten fences can be removed.

4.3.7 Top tips for plantings

- **Go for larger, more densely planted trees if you want to minimise future maintenance. Otherwise make allowance for weed control as part of the initial cost of the project.**
- **Plant a small area at a time, considering maintenance requirements.**
- **Schedule weed control in planted areas along with the rest of the farm. Consider having a contractor attend to these areas during the busy spring period.**
- **Ask around to source plants that are grown from local seed (ecosourced) to ensure you have the best-adapted plants that will help maintain local character.**
- **Purchase a smaller, cheaper grade of trees from a nursery and bag them up to grow on at home for the next season.**
- **Split up existing flaxes, rushes and sedges for a low-cost source of wetland plants. (Always get permission first if these are not on your land).**
- **Stake your plants at planting time so you can find them later. Place stakes consistently on one side of the plant (e.g. always to the south of the plant).**
- **Take care with herbicides around native plants. Find a contractor with experience releasing natives if spray is to be used.**
- **Deal with invasive weeds when they are small to avoid a major problem later.**
- **Keep on top of shade-tolerant weeds.**
- **Consider forest certification for larger blocks so that you have a documented record of silviculture procedures.**

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