Generic Wetland Management Plans for the Manuherekia Catchment

Contract Report No. 7498

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May 2025

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Cite this report as follows:

Wildland Consultants (2025). *Generic Wetland Management Plans for the Manuherekia Catchment.* Wildland Consultants Contract Report No. 7498. Prepared for Manuherekia Catchment Group. 40pp.

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1.0 Introduction

The Manuherekia Catchment Group (MCG) has funding to promote the restoration of wetlands in Manuherekia River Catchment in Central Otago. As part of the Ministry of Environment (MfE)-funded Waiora Manuherekia (WM) project, the MCG has identified the need for generic management plans to provide guidance for landowners in managing wetlands found on their properties.

The following management plans provide landowners with tools to help identify the type of wetland present on their property and how best to manage and enhance their wetlands. Five common wetland types have been identified within the Manuherekia Catchment and are covered in this plan: marsh, swamp, bog, fen and ephemeral wetlands.

2.0 Marsh

2.1 Marsh wetlands

Marshes are the most common type of wetland in the Manuherekia Catchment, that typically have shallow, often seasonal surface water. The substrate is predominantly mineral and contains medium to high nutrient levels. Marsh wetlands are often at the edge of other water bodies such as rivers, streams and lakes or at the edge of lakes or swamp margins. Marshes go through cycles of dryness or wetness seasonally and receive their water primarily from groundwater and surface water. Fluctuating water levels are a defining feature of marshes, along with their geographic location.

Marsh wetlands can play an important role in reducing flood risk as they are able to absorb heavy rain water and slowly release it. Marsh wetlands have been very widely drained for agricultural development, as they are often located on productive river flats. Inland marshes would have been historically dominated by copper tussock (*Chionochloa rubra* subsp. *cuprea*) and/or sedges (*Carex* spp). They had species of *Coprosma* spp. and *Olearia* spp. formerly but now often support only rushes (*Juncus* spp.) and sedges (Plate 1).

Plate 1 — Example of marsh wetland in the bottom of a gully at Chimney Creek, Otago.

2.1.1 How to identify a marsh wetland on your property

Marshes in the Manuherekia Catchment are likely to have standing water which may overtop a pair of gumboots in places at certain times of the year and be relatively dry at other times. The landscape setting of the wetland can help to determine if it is a marsh, for example, is the wetland located beside a waterway or at the edge of a different wetland? Marsh wetlands are also often found in the bottom of headwater gullies, with swamps further downstream.

Vegetation can include grasses, herbs, sedges and rushes. Exotic wetland grasses may be present in areas with deeper and flowing water. Native sedges such as rautahi (*Carex coriacea* or *Carex sinclairii*) may also be present. Rautahi dies back over winter which can help to identify this species. Trees and shrubs, including Crack willow (*Salix × fragilis*) and native shrubs may also be present. Valley floor marshes may form a matrix around small swamps that are permanently wet.

The soil substrate of marsh wetlands is mainly mineral. Peat (an accumulation of partially decayed vegetation or organic matter which is often dark red-brown in colour with partially decayed moss and plants) will be absent. A mineral substrate can vary in colour but will typically have a gritty, silty texture when rubbed between your finger and thumb.

Plate 2 — Marsh wetland near Hills Creek, Otago wetland dominated by native sedges.

2.2 Notable fauna and flora

Kōtuku/white heron (*Ardea alba modesta*, Threatened – Nationally Critical) will wade in the shallow waters of marsh wetlands to forage outside of their breeding season. Furthermore, dense areas of sedges and rushes within the marsh wetland can provide roosting, foraging and nesting habitat for matuku-hūrepo/Australasian bittern (*Botaurus poiciloptilus*, Threatened – Nationally Critical) and kotoreke/marsh crake (*Zapornia pusilla affinis*, At Risk – Declining).

Some species of native skinks, such as Otago green skink (*Oligosoma* aff. *chloronoton* "eastern Otago", At Risk – Declining) and tussock skink (*Oligosoma chionochloescens*, At Risk – Declining), can occur on marsh where lizard refuges (such as dense ground cover vegetation and rock piles) are not flooded.

Buchanan's sedge (*Carex buchananii*, At Risk – Declining) can occasionally be found in marshes.

Threatened and At Risk native fish may be found in waterways and channels associated with marsh wetlands. Roundhead galaxias (*Galaxias anomalus*, Threatened – Nationally Endangered) are only found in Otago and can be commonly found in weedy drains and cobble streams. Upland bullies (*Gobiomorphus breviceps*), although not threatened are a notable and common freshwater fish species found in a wide range of slow-flowing habitats throughout Aotearoa New Zealand.

2.3 Management requirements

2.3.1 Threats

Threats to marsh wetlands in the Manuherekia include drainage, weed invasion and soil compaction/pugging. Hydrology of a marsh wetland can be altered from man-made drains. The hydrology can also be altered over time by the establishment woody weeds such as crack willow. Stock can damage wetlands through pugging and compacting wetland substrates; this can also create gaps in existing vegetation and this disturbance allows for weeds to colonise and spread. Stock presence increases the nutrient load into wetlands. Occasionally, stock will browse native wetland plants, cattle like eating sedges in spring/early summer when they are more tender. Pest animals and predators have a negative impact on native fauna.

2.3.2 Characteristics of a healthy marsh wetland

The following characteristics can be used to help determine what a 'healthy' and functioning marsh wetland may look like in the Manuherekia.

- Wetland is hydrologically intact, for example no drains are present.
- Exotic woody weeds (crack willow, gorse, and broom) largely absent from the wetland. There may be scattered plants but not extensive areas of gorse and broom or dense large crack willow.
- The marsh is dominated by native plants. This can be difficult to determine as some native sedges and rushes can look superficially similar to exotic species and exotic grasses may also be present. If unable to tell what species are native and exotic, an indicator of health could be that the vegetation is dominated by sedges and rushes and/or has scattered shrubs of *Coprosma* or *Olearia*. Exotic grasses will likely be mixed in, however, if sedges and rushes are present it is likely that some if not all of these are native.
- Stock are excluded from the wetland are and/or little evidence of stock damage (pugging and browse) is observable.

Even if a marsh wetland does not have any of the 'healthy' characteristics, marsh wetlands have ecological value and can provide a number of benefits to the wider catchment. Marsh wetlands help to mitigate flood risk and provide a buffer to adjacent waterways, helping to filter nutrients and improve water quality. Rank grassland surrounding the wetland may provide habitat for lizards even if it is dominated by exotic grasses. Exotic trees and shrubs may provide habitat for birds, particularly if there are few examples in the surrounding area.

2.3.3 Steps to manage and enhance marsh wetlands

The following steps can be undertaken to manage marsh wetland habitats.

Remove and exclude livestock

Retiring areas from grazing combined with fencing to exclude livestock is an important management step. Any fences will also need to include the main wetland area, ideally including any waterways near the wetland. Once stock have been excluded, wetland restoration can commence.

Control invasive weeds

The control of woody weeds in and around marsh wetlands is a key priority for managing and enhancing wetland habitats.

Crack willow is common within marsh wetlands. Crack willow readily spreads and forms large, dominant tree lands which can alter the hydrology of the wetland. Willows can also reduce the flow of water in waterways and can block channels and increase impacts associated with flooding. The methods for controlling willow trees vary depending on the size and density. Small trees can be cut at the base and 'pasted' with glyphosate gel. Larger trees can be drilled, using either a chainsaw or large drill to make cuts into the trunk, through the cambium, cuts/holes need to be drilled in a ring around the trunk then filled with 100% glyphosate to poison the tree. The poisoned willow tree can be left in situ, provided there are no health and safety concerns relating to risks associated with falling limbs. In certain circumstances it may be appropriate to mechanically remove willow trees, this should be avoided where possible as this process has the potential to damage and compact wetland soils and create disturbance that favours weed invasions. An alternative is to cut back larger limbs and leave in situ. If mechanical removal is deemed necessary, care needs to be taken to reduce damage to the wetlands, for example avoiding multiple trips through the wetland and carefully selecting the route. Larger areas of dense, mature crack willow may require spraying which can done by a helicopter with boom spray. This must be done when willows have a full canopy. As willows readily regrow and resprout following control, regular surveillance needs to be undertaken to control shoots. More information on willow control can be found online [1] a resource consent may need to be applied for in some circumstance, check with the Otago Regional Council for guidance[2].

Removal of willows should be followed by native plantings of ecologically appropriate shrubs and sedges.

Other woody weeds such as gorse, broom, briar rose and elder are often present around wetlands, at the margins and in some cases within dryer parts of the wetland. These can be controlled through using cut and paste techniques, drilling or spraying. Where possible, manual control is preferable to spraying and ground spraying is preferable to aerial, this helps to reduce the quantity of herbicide entering waterways.

Exotic grasses and herbs are common in marsh wetlands. In most cases, removal is not required. Instead, the focus should be on promoting conditions for native plants to thrive, for example removing livestock and controlling woody weeds. Planting native species into areas dominated by exotic grasses, sedges and herbs to increase the cover of native vegetation and provide a seed source. In some cases, spot control of grasses, herbs and rushes may be justified to allow for native plantings and site preparation.

[1] https://landcare.org.nz/wp-content/uploads/2024/11/Willow-Alder-Guidelines-2015-1.pdf.

[2] https://www.orc.govt.nz/environment/land-care/land-use-in-otago/willow-management-in-otago/willow-removal-and-regulations/#:~:text=Where%20herbicide%20is%20to%20be%20used%20for%20kill,%28including%20neighbour%20notifications%29%20or%20apply%20for%20resource%20consent.

Ecologically appropriate planting

Once livestock are excluded, planting can be undertaken immediately. More details on planting and ecologically appropriate species for marsh wetlands in the Manuherekia Catchment are provided below.

Other actions to protect and enhance wetlands

- ***Control rodents and mustelids.*** Rodents and mustelids are predators of native animals, including cryptic birds in marshlands and lizards that may be present around wetland margins. This will need to be an ongoing action. Large rodent populations can also attract other predators, such as feral cats. Control methods include trapping and baiting.
- ***Limiting recreational access and maintaining tracks.*** Marsh soils are wet, soft and vulnerable to compaction. Recreational offroad vehicles (e.g. 4X4s, quad and dirt bikes), and even irresponsible trampers (walking off tracks), can cause severe and irreparable damage to wetland habitats. Both trampers and vehicles can also accidentally introduce and spread seeds of exotic plants. By limiting or restricting access and maintaining established tracks these impacts can be greatly reduced.
- ***Avoid drainage and habitat modification.*** Drainage of wetlands for development and agriculture has greatly reduced their extent in Otago. Where marshes have been 'reclaimed' through earthworks (bunds and dams), these can be broken down when the marsh is dry or left to collapse naturally. Historic drainage channels in or around these habitats should not be maintained. Over time these drains will fill back in with plants and debris and close naturally. Any connected drainage channels outside of these habitats should be considered for blocking or closing, and maintenance of drains adjacent to marsh wetlands should be evaluated for potential hydrological effects on the wetland.

2.4 Planting lists and guidance

Restoration planting can help to maintain and enhance the ecological values of marsh wetlands. Online tools can be used to help determine the area for planting and therefore how many plants may be required[1]. Before planting, the site will need to be prepared by clearing/controlling weeds and spraying areas of grass to create space for the plants (spot spraying). In general, spacing between sedges, grasses and rushes will be 0.5-1 meters, shrubs 1-2 meters and trees 2 meters. Best practice is to source plants as locally as possible. Using local plants is highly beneficial as they are adapted to local conditions and will persist better than the plants from other areas. Keeping records of the local species used, their source, time of planting and results will be helpful for future restoration projects. Good planting technique is also important, the following video prepared by the Manuherekia Catchment Group provides guidance on planting: https://www.youtube.com/watch?v=2j9ohGo9Tc8.

The following planting lists (Table 1 and 2) provides ecologically appropriate plants to include in wetland restoration plantings. Separate lists have been provided for planting within the wetland area (Table 1) and for any restoration planting which may occur around wetlands to provide a buffer (Table 2). In most cases, plant guards and mat will also be required.

[1] https://www.coastalrestorationtrust.org.nz/resources/crt-resources/planting-calculator/#:~:text=This%20handy%20tool%20allows%20you%20to%20figure%20out,It%20is%20reportedly%20used%20for%20riparian%20planting%20too.

Wetland planting

Planting directly into marsh can occur if the wetland is dominated by exotic species or if large gaps have opened up following removal of weeds such as crack willow. Care needs to be taken not to plant into areas where native species are present. Wetland areas and the margins of ponds should be planted in either September or October once any standing water has drained.

Terrestrial planting

Terrestrial planting of natives around the perimeter wetland will create a buffer which will help to protect the wetland habitat. The terrestrial planting lists are based on ecosystem mapping of what vegetation communities would have been present in the Manuherekia Catchment prior to human arrival and subsequent vegetation clearance. Potential ecosystem types have been mapped for the Manuherekia region, it is possible to cross refence your address to the potential ecosystem mapping for your area, and subsequent planting lists are also found online[1]. The planting list below includes a mixture of ecologically appropriate species to use as a basis for restoration planting. Plants highlighted in **bold** are particularly hardy and can be planted into dry and exposed habitats, these can be planted first to provide shelter and habitat for future plantings.

The locations of where plants will thrive in a restoration planting depends on the environmental tolerances of individual species. Therefore, the planting list suggests planting species which prefer wetter conditions on lower banks and at the edges of the wetland. Species which are more tolerant of dry and exposed conditions are recommended for lower, mid and upper banks or further from the wetland area. Timing of planting will be dictated by the rainfall patterns in the intended planting season but, in general, should be planted from late autumn, once soil moisture levels reach field capacity, through to mid-winter.

[1] https://storymaps.arcgis.com/stories/902888d6b5f84d1a9db1234e71379215.

Table 1 — Wetland planting list for marsh wetlands.

Common name	Species name	Max height	Growth rate	Notes
Trees				
Tī kōuka, cabbage tree	*Cordyline australis*	12m	Fast	Nectar source for birds, plant at edges of wetland
	Olearia lineata	5m	Moderate	Plant on the margins of wetlands
Shrubs				
Mingimingi	*Coprosma propinqua*	3m	Moderate	Fruit source for birds, plant at edges of wetland
	Olearia bullata	2m	Moderate	Provides habitat for moths, plant at edges of wetland
Sedges				
Cutty grass, rautahi	*Carex coriacea*	<1m	Fast	
Sinclair's sedge	*Carex sinclairii*	<1m	Fast	
Slender wine sedge	*Carext tenuiculmis*	<1m	Moderate	
Pūkio, swamp sedge	*Carex virgata*	<1m	Fast	
Bog rush, sedge tussock	*Schoenus pauciflorus*	<1m	Fast	Wetter areas
Grass				
Toetoe	*Austoderia richardii*	1m	Fast	
Herb (Monocot)				
Harakeke	*Phormium tenax*	2m	Fast	Nectar source for birds, plant at edges of wetland

Table 2 — Manuherekia terrestrial planting list for terrestrial habitats around marsh wetlands.

Common name	Species name	Max height	Growth rate	Planting position	Planting notes
Trees					
Piripiriwhata	*Carpodetus serratus*	10m	Moderate	Upper	Exposure tolerant
Tī kōuka, cabbage tree	***Cordyline australis***	12m	Fast	Lower, mid, upper	Exposure tolerant generalist
Kāpuka/broadleaf	***Griselinia littoralis***	10m	Moderate	Mid, upper	Exposure tolerant
Bog pine	*Halocarpus bidwillii*	5m	Moderate	Lower, mid, upper	Cold tolerant
Houhere	*Hoheria angustifolia*	18m	Moderate	Mid, upper	Long-lived tree
Kānuka	***Kunzea serotina***	2m	Fast	Mid, upper	Drought tolerance
Mountain celery pine	*Phyllocladus alpinus*	6m	Slow	Upper	Cold tolerant
Kōhūhū	***Pittosporum tenuifolium***	8m	Fast	Mid, upper	Exposure tolerant, warm, sheltered sites
Mānatu, ribbonwood	***Plagianthus regius***	20m	Fast	Mid, upper	Productive sites, deep soils
Hall's tōtara	*Podocarpus laetus*	20m	Slow	Upper	Exposure tolerant, long lived tree
Mataī	*Prumnopitys taxifolia*	25m	Slow	Upper	Deep soils, long lived tree
Fierce lancewood	*Pseudopanax ferox*	5m	Moderate	Upper	Dry sites
Kōwhai	***Sophora microphylla***	15m	Slow	Upper	Drought tolerant
Shrubs					
Leafy coprosma	*Coprosma dumosa*	3m	Moderate	Mid, upper	Exposure tolerant generalist
Mingimingi	***Coprosma propinqua***	3m	Moderate	Mid, upper	Exposure tolerant generalist
	Coprosma rotundifolia	3m	Moderate	Mid, upper	Moist sites
Mānuka	***Leptospermum scoparium***	5m	Fast	Lower, mid, upper	Exposure tolerant generalist in moist habitats
Weeping matipo	*Myrsine divaricata*	3m	Slow	Mid, upper	Exposure tolerant generalist
	Olearia bullata	2m	Moderate	Mid, upper	Exposure tolerant
	Olearia lineata	6m	Moderate	Lower, mid, upper	Exposure tolerant
Horopito	*Pseudowintera colorata*	2m	Slow	Mid, upper	Shade tolerant, upland habitats

Common name	Species name	Max height	Growth rate	Planting position	Planting notes
Grass					
Narrow-leaved snow tussock	***Chionochloa rigida***	<1m	Fast	Lower,mid	Exposure tolerant
Red tussock, copper tussock	***Chionochloa rubra***	<1m	Fast	Lower,mid	Exposure tolerant
Silver tussock	***Poa cita***	<1m	Fast	Lower, mid, upper	Exposure tolerant
Herb (Monocot)					
Harakeke	***Phormium tenax***	2m	Fast	Lower, mid	Exposure tolerant generalist

3.0 Swamp

3.1 Swamp wetlands

Swamps are wetlands in which water originates mainly from surface water with some ground water. Typically, swamps always have a visible and permanent surface water (Plate 3). Swamps have a combination of mineral and peat substrates, and occur in basins, valley floors, deltas, and plains.

Plate 3 — Example of a swamp wetland with raupō with shallow water in the foreground in a wetland near Cambrians, Otago.

3.1.1 How to identify a swamp wetland on your property

Swamp wetlands typically have deeper and more permanent water than other wetland types, and may be waist deep or higher in places with a moderate flow. Swamp wetlands will have some seasonal fluctuation in water levels but standing water will be present year-round.

The substrate of a swamp is typically peat and or mineral. Peat is an accumulation of partially decayed vegetation or organic matter which is often a dark red-brown in colour with partially decayed moss and plants). A mineral substrate can vary in colour but will typically have a gritty, silty texture when rubbed between your finger and thumb. The presence of permanent water will determine that the wetland is not a marsh, and productive sites will indicate the wetland is not a bog or fen.

The vegetation present in a swamp will depend on the modification (human impact) and the location. Lowland swamps that are less modified are typically dominated by pūkio, and other sward-forming sedges such as *Carex diandra* and native trees and shrubs including *Coprosma* species. Some lowland swamps are associated with shallow open water and are dominated by raupō (*Typha orientalis*) and/or *Machaerina* spp., instead of harakeke, sedges, and woody vegetation. Upland swamps occur at higher elevations upwards in the Manuherekia Catchment and are dominated by pūkio, rautahi (*Carex coriacea*), *Olearia bullata* and bog rush (*Schoenus pauciflorus*).

Modified swamps are usually dominated with exotic vegetation. Crack willow is a common feature of swamp wetlands, along with blue sweet grass (*Glyceria declinata*), monkey musk (*Erythranthe guttata*) and/or water cress (*Nasturtium microphyllum*) in deeper water.

Plate 4 — Swamp wetland dominated by Crack Willow and exotic grasses, Hills Creek, Otago.

3.2 Notable plants and animals

Swamp wetlands provide key habitat for various Threatened and At Risk avifauna (Robertson *et al.*, 2021). Kōtuku/white heron (*Ardea alba modesta*, Threatened-Nationally Critical) will forage and roost in inland swamps outside of their breeding season. Swamps with areas of raupo and sedges are favourable habitat of matuku-hūrepo/Australasian bittern (*Botaurus poiciloptilus*, Threatened – Nationally Critical), pūteketeke/Australasian crested grebe (*Podiceps cristatus australis*, Threatened-Nationally Vulnerable), kotoreke/marsh crake (*Zapornia pusilla affinis*, At Risk – Declining) and Australian coot (*Fulica atra australis*, At Risk – Naturally Uncommon). Shag species, such as māpunga/black shag (*Phalacrocorax carbo novaehollandiae*, At Risk – Relict) and kawaupaka/little shag (*Microcarbo melanoleucos brevirostris*, At Risk – Relict), are likely to utilise swamp wetlands with roosting opportunities, such as dead logs or trees over-hanging the water body.

Some species of native skinks, such as Otago green skink (At Risk – Declining) and tussock skink (At Risk – Declining), may be present around the margins of swamps, occurring where lizard refuges (such as dense ground cover vegetation and rock piles) are safe from flooding.

Notable plant species that can be found in swamps include swamp willowherb (*Epilobium chionanthum*, At Risk – Declining, regionally Threatened in Otago), and sedges such as Buchanan's sedge (At Risk - Declining).

Swamps are expected to be highly valuable habitat for freshwater invertebrates, as well as the larvae of a wide assortment of fly and beetle species.

Threatened and At Risk native fish may be found in waterways and channels associated with swamp wetlands. Roundhead galaxias (*Galaxias anomalus*, Threatened – Nationally Endangered) are only found in Otago and can be commonly found in weedy drains and cobble streams. Upland bullies (*Gobiomorphus breviceps*), although not threatened, are a notable and common freshwater fish species found in a wide range of slow-flowing habitats throughout Aotearoa New Zealand.

3.3 Management requirements

3.3.1 Threats

The main threats to swamp wetlands in the Manuherekia include drainage, nutrient run-off and weed invasions. Drains surrounding a wetland or other earthworks in or near wetlands have the ability to negatively impact the hydrology. Hydrology can also be altered over time by the establishment of woody weeds such as crack willow. Stock can damage wetlands through pugging and compacting wetland substrates; this can also create gaps in existing vegetation and allow for weeds to colonise and spread. High nutrient run-off from surrounding farming can negatively impact swamp wetlands and can cause algal blooms, excess growth of undesirable plants and lowers water quality and habitat for native aquatic invertebrates and fish (Peters and Clarkson 2010). Pest animals impact wetlands by damaging native plants, reducing seed-bank and eating eggs of native fauna.

3.3.2 Characteristics of a 'healthy' swamp wetland

The following characteristics can be used to help determine what a 'healthy' and functioning wetland may look like in the Manuherekia.

- Wetland is hydrologically intact, for example no drains are present.
- Exotic woody weeds (crack willow) largely absent from the wetland. There may be scattered plants but not extensive areas of gorse and broom or dense large crack willow.
- The swamp is dominated by native plants. This can include large distinctive native plants like raupō and pukio, as well as native trees and shrubs. Smaller native sedges, rushes and grasses can also be present in swamp wetlands.
- Stock are excluded from the wetland are and/or little evidence of stock damage (pugging and browse) is observable.

The extent of swamp wetlands has been greatly reduced in Otago, particularly in coastal habitats. Even if a swamp wetland does not have any of the 'healthy' characteristics, swamp wetlands have ecological value and can provide a number of benefits to the wider catchment. Swamp wetlands help to mitigate flood risk by acting as a pool of water. Rank grassland surrounding the wetland may provide habitat for lizards even if it is dominated by exotic grasses. Exotic trees and shrubs may provide habitat for birds, particularly if there are few examples in the surrounding area.

3.3.3 Steps to manage and enhance swamp wetlands

The following steps can be undertaken to manage swamp wetland habitats.

Remove and exclude livestock

Retiring areas from grazing combined with fencing to exclude livestock is an important management step. Any fences will also need to include the main wetland area, ideally including any waterways near the wetland. Once stock have been excluded, wetland restoration can commence.

Control invasive weeds

The control of woody weeds in and around swamp wetlands is a key priority for managing and enhancing wetland habitats.

Crack willow is common within swamp wetlands. Crack willow readily spreads and forms large, dominant tree lands which can alter the hydrology of the wetland. Willows can also reduce the flow of water in waterways and can block channels and increase impacts associated with flooding. The methods for controlling willow trees vary depending on the size and density. Small trees can be cut at the base and 'pasted' with glyphosate gel. Larger trees can be drilled, using either a chainsaw or large drill to make cuts into the trunk, through the cambium, cuts/holes need to be drilled in a ring around the trunk then filled with 100% glyphosate to gradually poison the tree. The poisoned willow tree can be left in situ, provided there are no health and safety concerns relating to risks associated with falling limbs. In certain circumstances it may be appropriate to mechanically remove willow trees, this should be avoided where possible as this process has the potential to damage and compact wetland soils and create openings for weed invasions. An alternative is to cut back larger limbs and leave in situ. If mechanical removal is deemed necessary, care needs to be taken to reduce damage to the wetlands, for example avoiding multiple trips through the wetland and carefully selecting the route. Larger areas of dense, mature crack willow may require spraying. Willows readily regrow and resprout following control, regular surveillance needs to be undertaken to control shoots. More information on willow control can be found online[1]. A resource consent may need to be applied for in some circumstance, check with the Otago Regional Council for guidance[2]

Removal of willows should be followed by native plantings of ecologically appropriate trees and shrub, filling in the gaps before exotic species reinvade.

Other woody weeds may be present in and around wetlands. Common alder (*Alnus glutinosa*) can be found in swamp wetlands throughout New Zealand and if detected in a wetland in the Manuherekia it warrants control. The control of exotic grasses and herbs is a lower priority in most circumstances; however, some exotic grasses and herbs are considered pest plants or environmental weeds (e.g. *Glyceria* species and monkey musk *Erythranthe guttata*).

Other actions to protect and enhance swamp wetlands

- ***Control rodents and mustelids.*** Rodents and mustelids are predators of native animals, including cryptic birds in marshlands and lizards that may be present around wetland margins. This will need to be an ongoing action. Large rodent populations can also attract other predators, such as feral cats. Control methods include trapping and baiting.
- ***Limiting recreational access and maintaining tracks.*** Swamp soils are wet and soft and vulnerable to compaction so not compatible with vehicles.
- ***Avoid drainage and habitat modification.*** Drainage of wetlands for development and agriculture has greatly reduced their extent in Otago. Where swamps have been 'reclaimed' through earthworks (bunds and dams), these can be broken down when the swamp is dry or left to collapse naturally. Historic drainage channels in or around these habitats should not be maintained. Over time these drains will fill back in with plants and debris and close naturally. Any connected drainage channels outside of these habitats should be considered for blocking or closing, and maintenance of drains adjacent to swamp wetlands should be evaluated for potential hydrological effects on the swamp wetland.

[1] https://landcare.org.nz/wp-content/uploads/2024/11/Willow-Alder-Guidelines-2015-1.pdf

[2] https://www.orc.govt.nz/environment/land-care/land-use-in-otago/willow-management-in-otago/willow-removal-and-regulations/#:~:text=Where%20herbicide%20is%20to%20be%20used%20for%20kill,%28including%20neighbour%20notifications%29%20or%20apply%20for%20resource%20consent.

3.4 Planting lists and guidance

Restoration planting in and around swamp wetlands can help to maintain and enhance the ecological values of these wetlands. Online tools can be used to help determine the area for planting and therefore how many plants may be required[1]. In general, spacing between sedges, grasses and rushes will be 0.5-1 meters, shrubs 1-2 meters and trees 2 meters. Best practice is to source plants as locally as possible. Eco sourcing plants helps ensure the survival of plantings as the plants are adapted to local environmental conditions. Good planting technique is also important, the following video prepared by the Manuherekia Catchment Group provides guidance on planting: https://www.youtube.com/watch?v=2j9ohGo9Tc8.

The following planting lists provides ecologically appropriate plants to include in wetland restoration plantings. Separate lists have been provided for planting within the wetland area and for any restoration planting which may occur around wetlands to provide a buffer. In most cases, plant guards and mat will also be required.

Wetland planting

Planting directly into swamp can occur if the wetland is dominated by exotic species or if large gaps have opened up following removal of weeds such as crack willow. Care needs to be taken to not plant into areas where native species are present.

Terrestrial planting

Terrestrial planting of natives around the perimeter wetland will create a buffer which will help to protect the wetland habitat. The terrestrial planting lists are based on ecosystem mapping of what vegetation communities would have been present in the Manuherekia Catchment prior to human arrival and subsequent vegetation clearance. Potential ecosystem types have been mapped for the Manuherekia region, it is possible to cross refence your address to the potential ecosystem mapping for your area, and subsequent planting lists are also found online[2]. The planting list below includes a mixture of ecologically appropriate species to use as a basis for restoration planting. Plants highlighted in **bold** are particularly hardy and can be planted into dry and exposed habitats, these can be planted first to provide shelter and habitat for future plantings.

The locations of where plants will thrive in a restoration planting depends on the environmental tolerances of individual species. Therefore, the planting list suggests planting species which prefer wetter conditions on lower banks and at the edges of the wetland . Species which are more tolerant of dry and exposed conditions are recommended for lower, mid and upper banks or further from the wetland area (Table 4).

[1] https://www.coastalrestorationtrust.org.nz/resources/crt-resources/planting-calculator/#:~:text=This%20handy%20tool%20allows%20you%20to%20figure%20out,It%20is%20reportedly%20used%20for%20riparian%20planting%20too.

[2] https://storymaps.arcgis.com/stories/902888d6b5f84d1a9db1234e71379215.

Table 3 — Wetland planting list for swamp wetlands.

Common name	Species name	Max height	Growth rate	Planting notes
Trees				
Cordyline australis	Tī kōuka, cabbage tree	12m	Fast	Exposure tolerant generalist
Shrubs				
Coprosma propinqua	Mingimingi	3m	Moderate	Exposure tolerant generalist
Olearia bullata		2m	Moderate	Exposure tolerant
Sedges				
Carex coriacea	Cutty grass, rautahi	<1m	Fast	Wet or moist sites
Carex diandra	Sedge	<1m	Fast	Wet or moist sites
Carex secta	Pūkio	<1m	Fast	Sandy, exposed sites
Carex sinclairii	Sinclair's sedge	<1m	Fast	Wet, fertile sites
Carex virgata	Pūkio, swamp sedge	<1m	Fast	Wet or moist sites
Schoenus pauciflorus	Bog rush, sedge tussock	<1m	Fast	Montane wetlands
Herb (Dicot)				
Urtica perconfusa	Swamp nettle	<1m	Fast	Fertile, swampy sites

Table 4 — Manuherekia terrestrial planting list for swamp wetlands.

Common name	Species name	Max height	Growth rate	Planting position	Planting notes
Trees					
Piripiriwhata	*Carpodetus serratus*	10m	Moderate	Upper	Exposure tolerant
Mikimiki, yellow wood	*Coprosma linariifolia*	6m	Moderate	Lower, mid, upper	Forest generalist
Tī kōuka, cabbage tree	***Cordyline australis***	12m	Fast	Lower, mid, upper	Exposure tolerant generalist
Inaka	*Dracophyllum longifolium*	3m	Slow	Lower, mid, upper	Exposure tolerant
Kāpuka/broadleaf	***Griselinia littoralis***	10m	Moderate	Lower, mid, upper	Exposure tolerant
Bog pine	*Halocarpus bidwillii*	5m	Moderate	Lower, mid	Cold tolerant
Houhere	*Hoheria angustifolia*	18m	Moderate	Mid, upper	Long-lived tree
Kānuka	***Kunzea serotina***	2m	Fast	Mid, upper	Drought tolerance
Mountain celery pine	*Phyllocladus alpinus*	6m	Slow	Upper	Cold tolerant
Kōhūhū	***Pittosporum tenuifolium***	8m	Fast	Mid, upper	Exposure tolerant, warm, sheltered sites
Mānatu, ribbonwood	***Plagianthus regius***	20m	Fast	Mid, upper	Productive sites, deep soils
Hall's tōtara	*Podocarpus laetus*	20m	Slow	Upper	Exposure tolerant, long lived tree
Mataī	*Prumnopitys taxifolia*	25m	Slow	Mid, upper	Deep soils, long lived tree
Fierce lancewood	*Pseudopanax ferox*	5m	Moderate	Upper	Dry sites
Kōwhai	***Sophora microphylla***	15m	Slow	Upper	Drought tolerant
Shrubs					
Leafy coprosma	*Coprosma dumosa*	3m	Moderate	Mid, upper	Exposure tolerant generalist
Mingimingi	***Coprosma propinqua***	3m	Moderate	Mid, upper	Exposure tolerant generalist
Mānuka	***Leptospermum scoparium***	5m	Fast	Lower, mid, upper	Exposure tolerant generalist in moist habitats
Weeping matipo	*Myrsine divaricata*	3m	Slow	Mid, upper	Exposure tolerant generalist
Rōhutu	*Neomyrtus pedunculata*	3m	Slow	Mid, upper	High rainfall areas
	Olearia bullata	2m	Moderate	Mid, upper	Exposure tolerant
	Olearia lineata	6m	Moderate	Lower, mid, upper	Exposure tolerant
Horopito	*Pseudowintera colorata*	2m	Slow	Mid, upper	Shade tolerant in upland sites

Common name	Species name	Max height	Growth rate	Planting position	Planting notes
Grass					
Narrow-leaved snow tussock	***Chionochloa rigida***	<1m	Fast	Lower, mid	Exposure tolerant
Red tussock, copper tussock	***Chionochloa rubra***	<1m	Fast	Lower, mid	Exposure tolerant
Silver tussock	***Poa cita***	<1m	Fast	Lower, mid, upper	Exposure tolerant
Ferns					
Shield fern	*Polystichum vestitum*	<1m	Fast	Lower, mid, upper	Moist sites

4.0 Bogs and Fens

4.1 Bog and fen wetlands

Bog and fen wetlands are types of wetlands which form peat (an accumulation of partially decayed vegetation or organic matter which is often a dark red-brown colour with partially decayed moss and plants). Bog and fen wetlands are superficially similar and have similar management requirements. Bog and fen wetlands are poorly drained with the water table typically just below the surface and typically lacking standing water associated with swamp and marsh wetlands. Bog wetlands typically occur on flat land or gentle slopes while fen wetlands are found on sloping land and in gullies, typically at the margins of other wetland types. True bog wetlands are fed by rain exclusively and are more acidic than fens, with lower nutrient levels and deeper peat layers. Fen wetlands receive inputs of water and nutrients from groundwater, rainwater and surrounding land and have a moderate flow of water. Bogs are poorly drained, with little to no water flow, and a stable water table.

Bog and fen wetlands are mostly restricted to upland areas in the Manuherekia Catchment.

Plate 5— Example of a copper tussock dominated fen wetland, Waipori, Otago. Photo credit ORC.

4.1.1 How to identify a bog or fen wetland on your property

Bogs and fens are typically 'less wet' than other wetland types and walking through a bog or fen wetland is unlikely to result in wet feet if wearing a pair of gumboots. The presence of peat (dark-brown partially decayed organic material) combined with a low water table indicates that the wetland is likely to be a fen or a bog.

Vegetation in bogs and fens includes mosses such as sphagnum moss (*Sphagnum* sp.), sedges, herbs, tussocks and woody vegetation. Vegetation in bogs is typically less diverse and often dominated by sphagnum moss (Plate 6). Vegetation in fens is more variable, one common vegetation type in fen wetlands is copper tussock fens.

Plate 6 — Vegetation characteristic of a bog or fen wetland, *Sphagnum* moss and tussock grasses, pugged by cattle. Photo credit ORC.

4.2 Notable plants and animals

Large bog and fen wetlands often support mātātā/fernbirds (*Poodytes punctatus*, At Risk – Declining).

Some native skinks, such as Otago green skink (At Risk – Declining[1]) and tussock skink (At Risk – Declining), may be present around the margins of bogs and fens where the water table is not too high and lizard refuges (such as dense ground cover vegetation and rock piles) are not flooded.

Bogs and fens are expected to be the most valuable wetland types for moths and flies, and are particularly notable habitat for *Sphagnum* ghost moths (*Heloxycanus patricki*, At Risk - Declining), and locally-endemic Otago ghost moths (*Aoraia ruvifena*), alongside other *Aoraia* species. These sites are also expected to support a wider array of typically terrestrial species, including naturally rare gound beetle genera such as *Holcaspis, Mecodema,* and *Megadromus* Ida Valley carabids (*Mecodema laeviceps*, Threatened – Nationally Critical; Leschen *et al.* 2012) may also be present, being known from wetlands and drier habitats, but have not been observed for over 50 years.

Notable plants in bog wetlands include the herbs swamp buttercup (*Ranunculus macropus,* At Risk – Naturally Uncommon), *Chaerophyllum colensoi* var. *delicatulum* (Threatened-Nationally Endangered), and the rush, *Juncus pusillus* (At Risk – Naturally Uncommon). A wide assortment of notable sedges in the genus *Carex* live in these habitats, including several At Risk and Threatened species, such as *C. capillacea* (Threatened – Nationally Vulnerable), *C. lachenalii* subsp. *parkeri* (At Risk – Naturally Uncommon), the At Risk – Declining species *C. kaloides*, and *C. dalliii.*

[1] National threat classifications for lizards are from Hitchmough *et al.* (2021).

4.3 Management requirements

4.3.1 Threats

Changes due to drainage are the main threats to bog and fen wetlands in the Manuherekia. The invasion and establishment of woody weeds such as gorse can be a sign that the hydrology has been impacted. Stock can damage wetlands through pugging and compacting wetland substrates; this disturbance can also create gaps in existing vegetation and allow for weeds to colonise and spread. Stock can contribute to increased nutrients in wetlands and often browse on the native vegetation. Pest animals and predators can have a negative impact on native fauna.

Black-backed gull (*Larus dominicanus*) colonies are known to breed on upland bogs. Their nutrient input changes the character of the bog by promoting exotic grass growth.

4.3.2 Characteristics of a 'healthy' bog or fen wetland

The following characteristics can be used to help determine what a 'healthy' and functioning wetland may look like in the Manuherekia.

- Wetland is hydrologically intact, for example no drains are present.
- Exotic woody weeds (gorse and broom) largely absent from the wetland. There may be scattered plants but not extensive areas of gorse and broom.
- Stock are excluded from the wetland area and/or little evidence of stock damage (pugging and browse) is observable.
- The bog or fen is dominated by native plants, including tussock grasses, sphagnum moss, sedges and woody plants.

Even if a wetland does not have any of the 'healthy' characteristics, bog and fen wetlands have ecological value and can provide a number of benefits to the wider catchment. Fens are likely to provide a buffer to other wetland habitats. Bog and fen wetlands are a type of peatland. All wetland types can store carbon, but peatlands excel in carbon storage. Peatlands hold the largest long-term store of carbon of any ecosystem type (Joosten 2016). Protecting and restoring wetlands is one of many measures needed to retain important carbon sources and mitigate climate change (Ramsar 2023).

4.3.3 Steps to manage and enhance bog and fen wetlands

The following steps can be undertaken to manage bog and fen wetland habitats.

Remove and exclude livestock

Retiring areas from grazing combined with fencing to exclude livestock is an important management step. Fencing and including a buffer zone would ideally include some terrestrial (non-wetland) areas surrounding the wetland to help filter nutrients and reduce the impact of surrounding land use on wetlands. Any fences will also need to include the entirety of the wetland area, ideally including any waterways near the wetland. Once stock have been excluded, wetland restoration can commence.

Control feral ungulates such as deer, goats, and pigs. These have similar effects to livestock. The greatest protection will be provided by deer exclusion and fencing.

Consider infilling or blocking drains

Drainage of wetlands for development and agriculture has greatly reduced their extent in Otago. Blocking or infilling drains will help restore the hydrological integrity of the fen and bog wetlands. Restoring the hydrology will prevent further woody weed invading the wetlands. The historic drainage channels could either be blocked, infilled or remain unmaintained. If left unmaintained, over time these drains will fill back in with plants and debris and close naturally. Any connected drainage channels outside of these habitats should be considered for blocking or closing, and maintenance of drains adjacent to bog or fen wetlands should be evaluated for potential hydrological effects on the wetland.

Control invasive weeds

The control of woody weeds in and around bog and fen wetlands is a priority for managing and enhancing wetland habitats. Weeds can out compete native vegetation, especially where disturbance has occurred, and may lead to changes in hydrology. Bog and fen wetlands are typically drier than marsh and swamp wetlands and have a different suite of invasive woody plants.

Woody weeds, gorse, broom, silver birch (*Betula pendula*), rowan (*Sorbus aucuparia*), and grey willow (*Salix cinerea*) often invade bog and fen wetlands. Blackberry (*Rubus* species) as well as wilding conifers, particularly pines (*Pinus* spp.) can also invade bog and fen wetlands. Spanish heath (*Erica lusitanica*) can be a problematic weed in open areas in Otago and has the potential to be a problem in the Manuherekia. Briar rose and elder are often present around drier wetlands margins.

- Small trees and shrubs including gorse, broom, silver birch, grey willow and wilding pines can be hand pulled if the stem diameter is less than 1cm. Only pull the plant if the roots can be cleanly pulled away from the ground. Ensure grey willow seedlings and saplings are placed to dry and die on top of another plant, otherwise the grey willow will re-root if it is still wet and touching the ground.
- Trees and shrubs with stem diameters between 1cm and 10cm can be cut back at the base, a glyphosate-based gel should be applied to prevent the tree from growing back. Again, place extra vegetative parts of grey willow above the ground. If the grey willow is too large to place above the ground, apply glysophate gel on the cut stump as well. Re-visit the grey willow off-cut to ensure it has died and not resprouted.
- Larger trees (grey willow, wilding conifers and birch) can be drilled using either a chainsaw or large drill to make cuts/holes into the trunk. Cuts/holes need to be drilled in a ring around the trunk then filled with 100% glyphosate to gradually poison the tree. The poisoned tree can be left in situ, provided there are no health and safety concerns relating to risks associated with falling limbs. Using, a drill to make holes in the tree, is the preferred method as the glyphosate is easily inserted using an injector pack and no glyphosate is spilled on the ground. This also allows for the glyphosate to be slowly absorbed by the tree.
- In certain circumstances, spraying large, dense areas of gorse, broom, grey willow may be appropriate. Care should be taken to ensure that spraying is targeted and will not result in herbicide entering water ways. A resource consent may need to be applied for in some circumstance, check with the Otago Regional Council for guidance[1] .

[1] https://www.orc.govt.nz/environment/land-care/land-use-in-otago/willow-management-in-otago/willow-removal-and-regulations/#:~:text=Where%20herbicide%20is%20to%20be%20used%20for%20kill,%28including%20neighbour%20notifications%29%20or%20apply%20for%20resource%20consent.

Briar rose and elder are often present around wetlands, at the margins and in some cases within dryer parts of the wetland. These can be controlled through using cut and paste techniques, drill and fill or spraying. Where possible, manual control is preferable to spraying and ground spraying is preferable to aerial, this helps to reduce the quantity of herbicide entering waterways.

Exotic grasses and herbs are common in bog and fen wetlands. In most cases, removal is not required. Instead, the focus should be on promoting conditions for native plant to thrive, for example removing livestock and controlling woody weeds. Planting native species into areas dominated by exotic grasses, sedges and herbs to increase the cover of native vegetation and provide a seed source. In some cases, spot control of grasses, herbs and rushes may be justified to allow for native plantings and site preparation.

Ecologically appropriate planting

Once livestock are excluded, planting can be undertaken immediately if the wetland and surrounding area is dominated by exotic species. If the bog or fen includes a range of native species, it may not be appropriate to plant. More details on planting and ecologically appropriate species for bog and fen wetlands in the Manuherekia Catchment are provided below.

Other actions to protect and enhance wetlands

- ***Control rodents and mustelids.*** Rodents and mustelids are predators of native animals, including cryptic birds in marshlands and lizards that may be present around wetland margins. This will need to be an ongoing action. Large rodent populations can also attract other predators, such as feral cats. Control methods include trapping and baiting.
- **Limiting fertiliser application**. The vegetation in bogs and fens is dominated by species that can grow in low-fertility environments. Addition of nutrients to these wetlands can cause the invasion of weeds that outcompete native species.

4.4 Planting lists and guidance

Restoration planting in and around bog and fen wetlands can help to maintain and enhance the ecological values of these wetlands. In many cases, planting is only appropriate if the wetland is heavily modified and lacking native species. Online tools can be used to help determine the area for planting and therefore how many plants may be required[1]. In general, spacing between sedges, grasses and rushes will be 0.5 metres, shrubs and large tussocks 1-2 metres and trees 2 metres. Best practice is to source plants as locally as possible. Eco sourcing plants helps ensure the survival of plantings as the plants are adapted to local environmental conditions. Good planting technique is also important, the following video prepared by the Manuherekia Catchment Group provides guidance on planting: https://www.youtube.com/watch?si=t9HOO5ov9sAtllLU&v=2j9ohGo9Tc8&feature=youtu.be

The following planting lists provides ecologically appropriate plants to include in wetland restoration plantings. Separate planting lists have been provided for planting within the wetland area (Table 5) and for any restoration planting which may occur around wetlands to provide a buffer (Table 6). In most cases, plant guards and mat will also be required.

[1] https://www.coastalrestorationtrust.org.nz/resources/crt-resources/planting-calculator/#:~:text=This%20handy%20tool%20allows%20you%20to%20figure%20out,It%20is%20reportedly%20used%20for%20riparian%20planting%20too.

Terrestrial planting

Terrestrial planting of natives around the perimeter wetland will create a buffer which will help to protect the wetland habitat, for bog and fen wetlands this is a higher priority than planting into the wetland. The terrestrial planting lists are based on ecosystem mapping of what vegetation communities would have been present in the Manuherekia Catchment prior to human arrival and subsequent vegetation clearance. Potential ecosystem types have been mapped for the Manuherekia region, it is possible to cross refence your address to the potential ecosystem mapping for your area, and subsequent planting lists are also found online[1]. The planting list below includes a mixture of ecologically appropriate species to use as a basis for restoration planting (Table 5). Plants highlighted in **bold** are particularly hardy and can be planted into dry and exposed habitats, these can be planted first to provide shelter and habitat for future plantings.

The locations of where plants will thrive in a restoration planting depends on the environmental tolerances of individual species. Therefore, the planting list suggests planting species which prefer wetter conditions on lower banks and at the edges of the wetland. Species which are more tolerant of dry and exposed conditions are recommended for lower, mid and upper banks or further from the wetland area.

Wetland planting

Planting directly into bog and fen wetlands can occur if the wetland is dominated by exotic species or if very large gaps have opened up following removal of weeds, or if restoring indigenous woody cover is a goal. If for example, a wetland is currently dominated by sphagnum moss or does not appear ‘diverse’ it is best to focus on other management actions. Bog and fen wetlands can often have a low diversity of native species (Table 6).

[1] https://storymaps.arcgis.com/stories/902888d6b5f84d1a9db1234e71379215.

Table 5 — Manuherekia terrestrial planting list for the margin of bog and fen wetlands.

Common name	Species name	Max height	Growth rate	Planting position	Planting notes
Trees					
Inaka	*Dracophyllum longifolium*	3m	Slow	Lower, mid	Exposure tolerant
Kāpuka/broadleaf	***Griselinia littoralis***	10m	Moderate	Mid, upper	Exposure tolerant
Bog pine	*Halocarpus bidwillii*	5m	Moderate	Lower, mid	Cold tolerant
Kānuka	***Kunzea serotina***	2m	Fast	Mid, upper	Drought tolerance
Hall's tōtara	*Podocarpus laetus*	20m	Slow	Upper	Exposure tolerant, long lived tree
Kōwhai	***Sophora microphylla***	15m	Slow	Upper	Drought tolerant
Shrubs					
Leafy coprosma	*Coprosma dumosa*	3m	Moderate	Mid, upper	Exposure tolerant generalist
Mingimingi	***Coprosma propinqua***	3m	Moderate	Mid, upper	Exposure tolerant generalist
	Coprosma pseudocuneata	3m	Moderate	Mid, upper	Plant only at high elevations
Mānuka	***Leptospermum scoparium***	5m	Fast	Lower, mid, upper	Exposure tolerant generalist in moist habitats
Weeping matipo	*Myrsine divaricata*	3m	Slow	Mid, upper	Exposure tolerant generalist
	Olearia bullata	2m	Moderate	Mid, upper	Exposure tolerant
	Olearia lineata	6m	Moderate	Lower, mid, upper	Exposure tolerant
Horopito	*Pseudowintera colorata*	2m	Slow	Mid, upper	Shade tolerant
Hebe	***Veronica odora***	1.5m	Fast	Lower, mid, upper	Montane wetland margins
Grass					
Narrow-leaved snow tussock	***Chionochloa rigida***	<1m	Fast	Lower, mid	Exposure tolerant
Red tussock, copper tussock	***Chionochloa rubra***	<1m	Fast	Lower, mid	Exposure tolerant

Table 6 — Wetland planting list for fen and bog wetlands.

Common name	Species name	Max height	Growth rate	Planting notes
Trees				
Dracophyllum longifolium	Inaka	3m	Slow	Exposure tolerant
Halocarpus bidwillii	Bog pine	5m	Moderate	Cold tolerant
Shrubs				
Coprosma elatirioides		1m	Moderate	Wet sites
Leptospermum scoparium	Mānuka	5m	Fast	Exposure tolerant
Veronica odora	Hebe	1.5m	Fast	Montane wetland margins
Sedges				
Carex coriacea	Cutty grass, rautahi	<1m	Fast	Wet or moist sites
Carex echinata	Star sedge	<1m	Fast	Wet or moist sites
Carex gaudichaudiana	Gaudichaud's sedge	<1m	Fast	Wet or moist sites
Carex sinclairii	Sinclair's sedge	<1m	Fast	Wet, fertile sites
Eleocharis acuta	Sharp spike sedge	<1m	Fast	Plant into wet areas
Schoenus pauciflorus	Bog rush, sedge tussock	<1m	Fast	Montane wetlands
Grass				
Chionochloa rigida	Narrow-leaved snow tussock	<1m	Fast	Exposure tolerant
Chionochloa rubra	Red tussock, copper tussock	<1m	Fast	Exposure tolerant
Herb (Dicot)				
Viola cunninghamii	Mountain violet, white violet	<1m	Fast	Riparian sites

5.0 Ephemeral

5.1 Ephemeral wetlands

Ephemeral wetlands are found throughout the Manuherekia Catchment, they can be found on glacial moraines, river flats and bedrock substrates (schist and limestone). Ephemeral wetlands are considered historically rare ecosystems, meaning that even prior to human modification of the catchment, they were limited in extent. Recent wetland mapping has noted hundreds of ephemeral wetlands within the Manuherekia Catchment.

Ephemeral wetlands are usually closed depressions with seasonally fluctuating water levels and soil wetness. Water levels and soil wetness can vary from complete inundation of depressions to substantial dryness in the summer months. These unique and extreme conditions have allowed distinctive low-stature herbaceous plant communities to develop within ephemeral wetlands.

5.1.1 How to identify an ephemeral wetland on your property

Ephemeral wetland can be subtle as they can be mistaken for ponds or pasture at certain times of the year. An ephemeral wetland is typically circular to oval and has a rounded shape. But some early irrigation schemes in the catchment had small ponds linked by water races and these can look similar to ephemeral wetlands. Look for wet depressions without outlet on your property which experience seasonal fluctuation in water levels. Standing water may be present towards the end of Autumn, winter and spring. The wetland will typically dry out over summer and will often be completely dry by the end of summer. The vegetation present in ephemeral wetlands will also often change in response to the seasonal changes. A typical ephemeral wetland will be comprised of a variety of compact turf species (dense low vegetation) and annual herbs. Sedges and rushes may be present around the edges. Ephemeral wetland can also be dominated by exotic grasses and herbs.

Plate 7 — Example of ephemeral wetland within the Kirk Creek Headwaters Marsh Complex, near the Ida Range, photo taken late February, once the wetland had dried out and exotic grasses had become dominant.

Plate 8 — Ephemeral wetland in the same wetland complex (Kirk Creek Headwaters Marsh Complex), photo taken in spring, with standing water.

Plate 9 — Example of a lowland ephemeral wetland which has dried up in Feburary. The dry bed of it can be habitat for indigneous turf plants.

5.2 Notable plants and animals

Ephemeral wetlands are a particularly unique ecosystem and have a number of threatened or rare plants that have adapted to the variable environmental conditions of ephemeral wetlands. Ephemeral wetlands support turf communities which contain native herbs and spring annual herbs. Notable species include the Threatened – Nationally Endangered species myrrh *Chaerophyllum colensoi* var. *delicatulum* and sneezeweed (*Centipeda minima* subsp. *minima*) the regionally Threatened species marsh willowherb, the At Risk – Declining species: *Euchiton ensifer*, *Epilobium angustum, Leptinella maniototo*, *Leptinella serrulata, Lobelia ionanth*a, New Zealand mousetail (*Myosurus minimus*), and *Ranunculus ternatifolius.*

Ephemeral wetlands can provide temporary foraging and roosting habitat for locally migrating birds. Grassy ephemeral wetlands with turf species will attract species such as tōrea/South Island pied oystercatcher (*Haematopus finschi,* At Risk – Declining) and pied stilt (*Himantopus himantopus leucocehalus*) for foraging, while an ephemeral wetland with significant areas of sedges and rushes around the edges may provide a temporary roosting or foraging habitat for locally migrating matuku-hūrepo/Australasian bittern.

Native lizards, such as tussock skink (At Risk – Declining) or McCann's skink (*Oligosoma maccanni*, Not Threatened), are unlikely to be present but may occur in drier areas and around the margins of ephemeral wetlands.

Ephemeral wetlands can support a wide array of invertebrate fauna including flies, land shrimp (*Talitridae* spp.), and non-wetland specialist insects such as the naturally rare ground beetle genera *Holcaspis, Mecodema,* and *Megadromus*. Ida Valley carabids (*Mecodema laeviceps,* Threatened – Nationally Critical) have been found in wetland and dry habitats, and may be well-suited to ephemeral wetlands, but have not been seen for over 50 years. Ephemeral wetlands are also likely to periodically support tadpole shrimp (*Lepidurus apis viridis*).

5.3 Management requirements

5.3.1 Threats

Ephemeral wetlands are critically endangered ecosystems. Ephemeral wetlands can be a lesser known wetland type and are not always obvious, this can mean they are overlooked and not prioritised for management. This puts ephemeral wetlands at a high risk of being filled in, drained, or for shallower ephemeral wetlands, oversown and cultivated. Other threats to ephemeral wetlands include nutrient enrichment, sedimentation that alters the base permeability of the wetland, weed invasion, and soil compaction by stock and vehicles.

5.3.2 Characteristics of a 'healthy' ephemeral wetland

A healthy wetland will lack human induced disturbance including cultivation, infilling, drainage, compaction by stock or vehicles. The ephemeral wetland will have native turf plant communities with minimal invasion of exotic weeds including pasture grasses. Assessing the 'health' or condition of an ephemeral wetland may require a trained ecologist or someone with botanical field skills to identify the presence of different indigenous vegetation communities. The timing of assessments and surveys is also important and needs to occur as the wetland begins to dry out in January to maximise the chance of detecting threatened plants and spring annual herbs.

5.3.3 Steps to manage and enhance ephemeral wetlands

Ephemeral wetlands are more sensitive to changes than other wetland types and are also not as well understood. If you suspect you have an ephemeral wetland on your property, seek input and guidance from experts and council before undertaking any major changes in current management. The following information can provide guidance on managing ephemeral wetlands, however, working with an expert to create a more targeted management plan may be required. Ephemeral wetland conservation management is relatively new, and it is therefore important to record management actions undertaken and take photos.

Identify the presence of ephemeral wetlands. As mentioned previously, it is possible to have an ephemeral wetland on your property without realising it. Identifying an ephemeral or potential ephemeral wetland on your property is a crucial first step for managing and protecting this particularly special type of wetland. If there is doubt about the type of wetland or if it is an ephemeral wetland, seek input from your local Otago Regional Council Catchment advisor or a specialist wetland ecologist. Seeking external support and advice can also help to ensure the best management strategy is developed for the wetland.

Avoid cultivation, drainage and habitat modification. Where ephemeral wetlands occur in and around agricultural land, many shallower wetlands have been lost or modified through cultivation, infilling, and drainage. Once identified, efforts can be made to protect these habitats by setting them aside and avoiding further damage. With support and advice from an expert, consider blocking and infilling any existing drainage channels to allow temporary ponding to occur within the wetland basin.

Limit livestock and nutrient enrichment. Ephemeral wetlands are fragile systems prone to trampling or browsing damage by cattle or deer, as well as nutrient enrichment from stock and fertiliser. However, some level of grazing by sheep and compaction is often required to maintain these communities. Light seasonal grazing by sheep is often the best way of managing the shallower ephemeral wetlands. Grazing cattle or deer should be avoided, and sheep grazing should only occur in the growing season when the exotic grasses and herbs are actively growing. Once livestock have been limited and cattle excluded, careful use of fertiliser around ephemeral wetland will help to reduce nutrients going into the ephemeral wetland system.

Limiting vehicle access and maintaining tracks. Ephemeral soils are vulnerable to compaction. Farm or recreational offroad vehicles (e.g. 4X4s, quad and dirt bikes), can cause severe damage to wetland habitats. Limit vehicle access and movement and retire or realign any tracks which run through ephemeral wetlands. Place large rocks around the wetland to ensure it can't be driven on but allows access for sheep and other avian grazers.

With help from a specialist ecologist or council support:

- **Control invasive weeds**. Weeds can crowd out native plants, and can quickly establish in areas of exposed soil. Large woody weeds that are easily recognised such as willows and gorse should be a priority, but care is needed as ephemeral wetlands are known to contain uncommon and/or threatened plant species that can easily be overlooked. A survey to identify species present recommend prior to weed control. Knowing the plant species present will help determine the weed control method required.
- **Re-introduce turf plant communities**. Some ephemeral wetlands that are isolated and located in highly modified landscapes may be completely devoid of native species. This will require a field survey and advice from a wetland specialist/ecologist. Extra water might need to be added.

Acknowledgments

Emily Hart, Clare Hadley and Haines Battrick of the Manuherekia Catchment Group are thanked for their assistance with field surveys and ongoing input and liaison.

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Appendix 1

How to identify weed species found in wetlands in the Manuherekia Catchment

Crack willow (*Salix × fragilis*)[1]

- Deciduous tree which can grow up to 25 m tall. Often found in marshes and swamps and on stream banks in the Manuherekia. Leaves are narrow, alternating, finely serrated and lance-shaped (narrow, long and tapering to a point).
- Trees often form dense stands due to root suckering (where new shoots emerge from the roots of a plant, which will eventually form another tree), and can spread into both dry and submerged areas.

Plate A1-1 – Crack willow leaves: long alternating leaves with visible galls. Photo: D.J. King.

Plate A1-2 – Large crack willow tree.

Grey willow (*Salix cinerea*)[2]

- Deciduous tree or shrub usually less than 7 m tall. Trees often form dense stands due to suckering.
- Pale yellowish, crumpled-looking, leathery, oval-shaped leaves with grey, hairy undersides.
- Catkins (flowers) appear before the leaves and are 1.5 to 3.5 cm long.
- Can be found in bogs, fens, swamps, and marshes, but tend to be found in drier habitats than crack willow.

Plate A1-3 – Alternating pale-green, leathery leaves and catkins of a typical grey willow. Photo: D.J. King.

Plate A1-4 – A stand of mature grey willows in a marsh wetland in Southland. Photo: D.J. King.

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/crack-willow/

[2] https://www.weedbusters.org.nz/what-are-weeds/weed-list/grey-willow/

Gorse (*Ulex europaeus*)[1]

- A very common invasive shrub up to 2 m tall, which forms very dense branches and stands.
- Covered in long, branching spikes. Stems are often covered in fine grey hair, except in young growth.
- Yellow flowers with forward-facing petals.

Plate A1-5 – Gorse flowers on branch covered in spikes. Photo: D.J. King.

Plate A1-6 – Gorse flowers on branch covered in spikes. Photo: D.J. King.

Broom (*Cytisus scoparius*)[2]

- Common invasive shrub with densely-branched, distinctively grooved/ridged stems.
- Leaves are small (up to 1.5 cm) and usually have three clover-like leaflets.
- Typically forms dense stands and is found in drier habitats.
- Yellow, pea-like flowers that become seed pods 2-3 cm in length.

Plate A1-7 – Broom leaves and flowers. Photo: D.J. King.

Plate A1-8 – Broom leaves and flowers. Photo: D.J. King.

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/gorse/
[2] https://www.weedbusters.org.nz/what-are-weeds/weed-list/broom/

Briar rose (*Rosa rubiginosa*)[1]

- Deciduous, densely thorny shrub up to 3 m tall, though usually smaller.
- Thorns are backward-curved (either strongly or subtly).
- Leaves have two to three pairs of oval-shaped, rounded or narrow leaflets, and an additional leaflet at their ends. Leaflets have serrated edges.
- White to red flowers (typically pink) 2.5 to 4 cm in diameter, with five broad, rounded to trapezoidal petals.
- Flowers give way to a distinctive red or orange, shiny, oval-shaped fruit.

Plate A1-9 – Briar rose foliage and flower. Photo: D.J. King.

Plate A1-10 – Shiny, oval-shaped briar rose fruits. Photo: Marie Portas. https://commons.wikimedia.org/wiki/File:Rosa_rubiginosa_fruit_(04).jpg

Elder (*Sambucus nigra*)[2]

- Deciduous tree or shrub up to 6 m tall, and can spread to 6 m across.
- Leaves grow opposite, and can be up to 30 cm long. Leaves combine several pairs of leaflets (typically two to four pairs), with an additional leaflet at the end. Leaflets are lance-shaped to oval-shaped, pointed, and have serrated margins.
- Elder has flat-topped clusters of many small, white flowers 10-25 cm across, which become clusters of small black berries.
- Grows in dry and wet habitats.

Plate A1-11 – Cluster of elder flowers and elder leaves. Photo: D.J. King.

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/sweet-briar/

[2] https://www.weedbusters.org.nz/what-are-weeds/weed-list/elder/

Common alder (*Alnus glutinosa*)[1]

- Deciduous tree up to 28 m tall, which usually grows in swamps and around the edges of lakes, ponds, rivers, and streams.
- Alder has strongly veined, often somewhat crenulated, wide, alternating leaves that have finely serrated margins. Leaves have thick, noticeable veins that run in an alternating arrangement out from the centre. Young leaves are slightly sticky.
- Alder has two types of flowers: Male catkins, which are downwards-hanging and disperse pollen by wind, and female cones, which are small, hard, and woody.
- Often has a distinctive pyramid-shaped canopy when mature.

Plate A1-12 – Mature leaves showing thick veins. Photo: Jeremy R. Rolfe. https://www.nzpcn.org.nz/flora/species/alnus-glutinosa/

Plate A1-13 – Alder flowers. Male catkins (top, hanging) and female cones (below). Photo: Colin C. Ogle. https://www.nzpcn.org.nz/flora/species/alnus-glutinosa/

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/alder/

Silver birch (*Betula pendula*)

- Deciduous tree up to 25 m tall, with a distinctive silvery white bark on the trunk, which tends to peel. The bark is notably yellowish brown in young trees, and gradually becomes silver-white as it matures.
- Mostly found in bog wetlands and around the edges of water bodies.
- Branches tend to droop, and drooping leaves are present along their lengths. Leaves are rhombus-shaped to triangular, distinctively pointed, have serrated edges, and have thick, paired or alternating veins along their length (up to 6 cm).
- Trees have male catkins first, which are skinny, up to 9 cm long, and downward-hanging. These become female catkins, which are shorter and up to 2.5 cm long.

Plate A1-14 – Silver birch leaves. Photo: D.J. King.

Plate A1-15 – Male silver birch catkins. Photo: Benjamin David.
https://inaturalist.nz/observations/279383620

Plate A1-16 – A stand of silver birch trees. Photo: Percita.
https://en.wikipedia.org/wiki/Betula_pendula#/media/File:Betula_pendula_Finland.jpg

Rowan (*Sorbus aucuparia*)

- A deciduous tree that grows up to 8 m tall, and sometimes invades bog wetlands.
- Leaves are long and comprise up to eight pairs of narrow, lance-shaped, jaggedly or finely-toothed leaflets, each up to 5 cm long and tapering to a point, with an additional leaflet at their ends.
- Rowan has clusters of small white flowers with long stamens that can give the clusters a fuzzy appearance. These flowers become bunches of small orange or red berries.

Plate A1-17 – Rowan foliage and berries. Photo: D.J. King.

Plate A1-18 – Rowan flowers. Photo: Matt Lavin. https://inaturalist.nz/observations/115952248

Spanish heath (*Erica lusitanica*)[1]

- Pale-green, erect-growing shrub up to 2 m tall, covered in narrow, needle-like leaves less than 1 cm long.
- Branches are upwards-pointing, and young shoots are covered in small hairs.
- These shrubs invade bogs and marshes, but also do well in dry conditions.
- When flowering, their branches can become densely covered in small, bell-shaped, white to pink flowers, which hang downwards from small stalks.

Plate A1-19 – A Spanish heath shrub covered in small, bell-shaped flowers. Photo: D.J. King.

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/spanish-heath/

Blackberry (*Rubus fruticosus*)[1]

- Scrambling shrub or vine which tends to grow long to the ground and form dense thickets. Stems are covered in sharp, backwards-facing thorns.
- Found in scrub, in bog and fen wetlands, and at the margins of other wetland types.
- Blackberry leaves comprise five broad but pointed, oval-shaped, serrated leaflets which extend from stalks from a centre-point. Leaves are sometimes prickly on their undersides.
- Blackberry have white to pink rose-like flowers 1.5 to 6 cm in diameter, with five petals. Flowers give way in late summer to red to black compound berries, which darken as they mature.

Plate A1-20 – Blackberry foliage, stems and thorns, showing the distinctive shape of their leaves. Photo: D.J. King.

Plate A1-21 – Compound blackberry fruits. Photo: D.J. King.

Wilding pine (*Pinus species*)

- Fast-growing evergreen conifers up to 30 m tall with upwards-pointing branches covered in long, needle-like leaves that grow in bundles.
- Pine trunks usually have thick, deeply-grooved bark. Pine branches have leaf scars (knobbly bark with prominent small lumps where leaves used to be attached).
- Pines have small bunches of male cones similar to catkins, and much larger female cones (classic “pine cones”).

Plate A1-22 – Pine foliage. Photo: D.J. King.

[1] https://www.weedbusters.org.nz/what-are-weeds/weed-list/blackberry/

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