

# MAHINGA KAI AND ECOLOGICAL RESTORATION PLAN FOR COLDSTREAM 2, RANGITATA RIVER, SOUTH CANTERBURY

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*Mossfield at Coldstream 2, Rangitata River, South Canterbury. 9 July 2021.*

## **Contract Report No. 5920b**

March 2022

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## 1. INTRODUCTION

The Rangitata River and its catchment have been identified as a priority under the Department of Conservation Nga Awa source to sea restoration programme<sup>1</sup>. The programme will provide a multi-agency approach to managing the Rangitata River. The agencies involved include the Department of Conservation, Te Rūnanga o Arowhenua, Fish and Game – Central South Island Lakes, Ashburton District Council, Timaru District Council and Environment Canterbury and they have formed a steering group (the Rangitata Steering Group) to oversee the restoration work. The Rangitata Steering Group has identified six sites within the lower Rangitata River catchment as initial priorities for restoration, and commissioned Wildland Consultants Ltd to develop high level ecological and mahinga kai restoration plans for these sites.

This report provides a restoration plan, to be implemented over a four-year timeframe, for the Coldstream 2 site. This dryland river terrace is situated on the north side of the Rangitata River, approximately six kilometres upstream from the mouth. Wildlands has prepared similar plans for the five other Rangitata sites: Coldstream 1, Rangitata Hāpua, Ealing Springs, McKinnon's Creek and the main stem of the Rangitata.

## 2. SITE GOALS

Overarching project goals and objectives are needed to provide guidance for the ecological restoration works at Coldstream 2. These goals have been aligned with those identified by the Rangitata Steering Group.

### 2.1 Ecological restoration project goals

- To implement a robust ecological restoration plan that will increase the mauri and ecological integrity of the dryland vegetation and habitat types within the Coldstream 2 site.
- To increase the diversity and abundance of indigenous plant and animal species that would have historically occurred at the site.
- The integral role that Te Rūnanga o Arowhenua play as kaitiakitanga over the Rangitata River is respected and incorporated in the restoration plan and project.

### 2.2 Ecological restoration project objectives

By the end of the four-year timeframe of the project, the following will be achieved:

- Detailed ecological surveys have been completed and there is a high degree of understanding regarding the ecological values that are present at the site.
- Remnant areas of dryland mossfield-lichenfield/gravelly-stonefield, and associated habitats for indigenous fauna such as lizards and invertebrates are protected and are being enhanced through active management.

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<sup>1</sup> See: <https://www.doc.govt.nz/our-work/freshwater-restoration/nga-awa/>

- The main threats at the site (e.g. pest plants, pest animals) have been identified and are being actively managed in cost effective ways.
- Opportunities for the restoration of Mahinga kai species at the site are identified and, if implemented, follow Department of Conservation translocation protocols and Te Rūnanga o Arowhenua tikanga.
- Ongoing management decisions are informed by a robust monitoring programme that is implemented at appropriate timeframes.
- The ecological importance of the site is highlighted to the wider community through public engagement (e.g. volunteer planting days, website updates).

### 3. SITE VISIT

Ecological and mahinga kai values, threats and restoration opportunities that are present at Coldstream 2 were identified by the Rangitata Steering Group and provided as written summaries.

Additional information was gathered during a site visit and meeting on 9 July 2021. Participants included two Wildlands ecologists and representatives from the Department of Conservation. The purpose of this meeting was to discuss the key attributes and opportunities for restoration at Coldstream 2. Only the extreme upstream boundary and central dryland terrace was visited. The site was not surveyed in detail during the site meeting but vegetation types and habitats, potential restoration areas, and pest plants were mapped on aerial photos. The vegetation and habitats within un-surveyed areas were mapped using recent aerial photos and Google Earth imagery.

### 4. SITE DESCRIPTION

The Coldstream 2 site comprises approximately 132 hectares of low river terrace on the true left of the Rangitata River and is located within the Rangitata River Conservation Reserve. The site is bounded on the true left by the current active bed of the river, and by a terrace scarp on the true right, which marks the former extent of the riverbed. Historic photographs from the 1930s indicate that the site was relatively open and connected to the active floodplain via dry river channels. By the 1960s these gravel side braids were vegetated, and the river confined to the current floodplain. The site is currently leased for sheep (*Ovis aries*) grazing. Stocking rates are unknown, but the amount of trampling and sign observed during the site visit suggests rates are moderate-high at times. This site is predominantly terrestrial, with limited aquatic habitats, although its western boundary abuts the current active braid of the Rangitata River and the northern section of the site potentially contains a wetland.



## 5. ECOLOGICAL VALUES

### 5.1 Vegetation and habitat types

Seven vegetation and habitat types were identified during the site visit. Further field surveys are needed to identify additional vegetation and habitats, and the species they contain at the site. The vegetation and habitat types are listed below. Descriptions of these types, and their distribution, is provided in Appendix 1.

1. Exotic conifer forest (shelterbelt) and treeland
2. Crack willow forest and treeland
3. Gorse shrubland
4. Gorse-Scotch broom-blackberry shrubland
5. Exotic grassland
6. Mossfield-lichenfield/ gravelfield-stonefield
7. Stonefield (riverbed)

### 5.2 Notable flora

Although gorse and exotic grass species dominate much of the site, the area is believed to retain significant botanical values. Ecologically intact moss, lichen and gravel-stone fields are now relatively rare in lowland Canterbury (Harding, 2010), and warrant protection and active management. Notable indigenous species recorded during the site visit included tī kōuka (cabbage tree; *Cordyline australis*) (mahinga kai species) in the dry stream at the western extent of the site, and two mature kōwhai (*Sophora microphylla*) and matagouri (*Discaria toumatou*; At Risk – Declining as per de Lange *et al.* 2018) within the mossfield-lichenfield and gravelfield/stonefield.

Mossfield-lichenfield/gravelfield-stonefields (hereafter dryland mossfield/stonefield) are natural features of alluvial terraces, particularly on accumulations of coarse stone with limited water holding capacity beneath a thin organic crust. However, they may also be maintained by browsing and grazing pressure, where succession to woody vegetation that would normally occur is being perturbed. While an ecologically important feature of this site, it is unknown if the dryland mossfield/stonefields are remnants or the result of browsing and grazing.

### 5.3 Landscape value

Although modified, the site retains good landscape values due to the lack of agricultural development. This lack of development has meant the retention of dryland habitats and a topography characterised by former river channels and terraces.

### 5.4 Avifauna

Twenty-eight indigenous and 15 exotic bird species were recorded on eBird within 10 kilometres of the Coldstream 2 site (species listed in Appendix 2). Two species listed as Threatened (as per Robertson *et al.* 2021) have been recorded near the mouth of the Rangitata River: tara piroe/black-fronted tern (*Chlidonias albobristatus*; Threatened – Nationally Endangered) and taranui/Caspian tern (*Hydroprogne caspia*; Threatened – Nationally Vulnerable). These species will predominantly utilise the

braided river area. A further six species that are listed as At Risk have been recorded near the site: tōrea/South Island pied oystercatcher (*Haematopus finschi*; At Risk – Declining), tōrea pango/variable oystercatcher (*Haematopus unicolor*; At Risk – Recovering), tara/white-fronted tern (*Sterna striata striata*; At Risk – Declining), tūturiwhatu/banded dotterel (*Charadrius bicinctus bicinctus*; At Risk – Declining), tarāpunga/red-billed gull (*Larus novaehollandiae scopulinus*; At Risk – Declining), tarāpuka/black-billed gull (*Larus bulleri*; At Risk – Declining), karuhiruhi/ pied shag (*Phalacrocorax varius varius*; At Risk – Recovering), Little shag (*Phalacrocorax melanoleucos brevirostris*; At Risk – Relict) and kawau/black shag (*Phalacrocorax carbo novaehollandiae*; At Risk – Relict). South Island pied oystercatcher and black shag are likely to be present, at least periodically, at the Coldstream 2 site. Banded dotterel and black-billed gull may periodically use pastoral land to forage, and banded dotterel may breed in short grassland (Heather and Robertson 2015). Variable oystercatcher, red-billed gull, white-fronted tern and pied shag are highly unlikely to be seen within the Coldstream 2 site.

## 5.5 Freshwater fauna

Based on aerial imagery, a small stream is present at the northern end of the site. However, the extent of this waterbody is unknown and no information regarding freshwater values exists for the site. Due to the limited scale of the willow forest, it is likely that the stream is narrow and may only provide limited habitat for indigenous aquatic fauna species.

## 5.6 Other fauna

Southern grass skinks (*Oligosoma* aff. *polychroma* Clade 5; At Risk – Declining as per Hitchmough *et al.* 2015) have been recorded at the site (Frank 2021). Only a few remnant populations of this species remain on the south side of the Rangitata River, and therefore the presence of this skink species at the Coldstream 2 site is significant. Large populations of boulder copper butterflies (*Lycaena boldenarum* and *L. salustis*) have also been recorded at the site (Frank 2021).

# 6. CULTURAL VALUES

## 6.1 Significant sites

A historical braid path that connected the hāpua at Pakihau Kutu with inland areas passes through the Coldstream 2 site. The restoration of this pathway may be a longer-term objective of the project.

## 6.2 Mahinga Kai

No site-specific mahinga kai opportunities have been identified for Coldstream 2. However, potential restoration sites for harakeke (*Phormium tenax*), rārahu (*Pteridium esculentum*), tī kōuka and tutu (*Coriaria* spp.) exist in the northern and western areas of the site (Appendix 3). In addition, Te Rūnanga o Arowhenua have aspirations to introduce and sustainably harvest western weka (*Gallirallus australis australis*) along the Rangitata River. However, a detailed assessment of the feasibility for translocation

should be undertaken before attempting any releases of this species. Testing of mahinga kai to ensure safety (e.g. heavy metal contamination of freshwater mussels or watercress) should be conducted before harvest.

## 7. ECOLOGICAL THREATS

### 7.1 Environmental pest plants

Invasive plants (pest plants) are a primary threat to habitats that are present at the site, and particularly the dryland mossfield/stonefields. In addition, the pest plants at Coldstream 2 will directly compete with existing areas of indigenous vegetation and restoration plantings, will inhibit the recruitment of indigenous seedlings and saplings, and act as a propagule source for nearby areas.

Seven environmental pest plants<sup>1</sup> present at Coldspring 2 are listed in Appendix 4. All of these species should be controlled within the site as time and finances allow. Three of the environmental pest plant species recorded at the site are included in the Canterbury Regional Pest Management Plan 2018-2038 (Environment Canterbury 2018). Even if eradicated from the restoration site, pest plants will remain a long-term management issue due to the propagule pressure they exert, and their ability to rapidly reinvade.

### 7.2 Pest animals

Introduced mammal species are negatively impacting indigenous vegetation and the population density and persistence of terrestrial indigenous vertebrate and invertebrate species at the site. Specifically, the pest animals may be having the following impacts:

- Mice (*Mus musculus*), rats (*Rattus* spp.), mustelids (*Mustela* spp.), feral cats (*Felis catus*), brushtail possums (*Trichosurus vulpecula*) and European hedgehogs (*Erinaceus europaeus*) are likely to be negatively impacting the population density and persistence of terrestrial indigenous fauna such as indigenous lizards and ground nesting birds.
- Rabbits (*Oryctolagus cuniculus cuniculus*) and hares (*Lepus europaeus*), and possums will be impacting indigenous flora at the site.
- Feral pigs (*Sus scrofa*), feral goats (*Capra hircus*) and deer (most likely red deer; *Cervus elaphus scoticus*) may periodically occur within the corridor of the Rangitata River, and therefore may access the site. Pigs can cause considerable damage to the margins of wetlands and streams, while goats and deer are capable of causing the localised decline of palatable indigenous plant species.

Pest animals will remain a long-term management issue due to reinvasion from surrounding populations. Maintenance of the restoration gains will require long term animal pest control.

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<sup>1</sup> Pest plant species that are known to have demonstrable negative impacts.

### 7.3 Livestock

The large area of dryland mossfield/stonefield is currently grazed by sheep. Although this grazing is likely to be maintaining areas of open habitat, these livestock will also be browsing and potentially preventing the recruitment of palatable indigenous plant species at the site. The appropriate grazing regime will depend on the end-point restoration goals identified by the steering group and the required disturbance regime needed to maintain the habitats.

### 7.4 Further agricultural development and loss of topographic complexity

Further agricultural development of the site for livestock grazing, particularly conversion to dairy production, should be prevented. Any loss of topographic complexity (former river channels and terraces) should also be prevented.

### 7.5 Flooding and erosion by the river

While changes in the course of braided rivers is a natural process, migration of the river channel poses a moderate threat to the retention of now remnant plant communities and habitats at the site over longer time-periods.

There is an inherent tension between the dynamism of the braided river system and site-based management of rare ecosystems within narrow river corridors whose boundaries have been effectively fixed by changes in surrounding land use. Within such sites the selection of appropriate management actions will require a balance between allowing natural processes and inherent dynamism of the river, and the protection of refugia for once widespread but now restricted species and habitats.

The proposed braid plain restoration actions at the upstream Coldstream 1 site are unlikely to impact the Coldstream 2 site. Maintaining a wide vegetated berm on the south side of the Rangitata likely poses a greater flood risk, as this constrains the main channel to a relatively narrow section of the river pushed against the Coldstream 2 site.

### 7.6 Fire

The extensive areas of gorse (*Ulex europaeus*), Scotch broom (*Cytisus scoparius*) and blackberry (*Rubus fruticosus*) shrubland, and exotic grassland are a high fire risk, particularly during droughts. Wildfires within the margins of the Rangitata River could cause the local extirpation of indigenous plants and animals (particularly lizards and non-volant invertebrates) at the site. Based on an assessment of aerial imagery, the site burnt during or shortly before 2009. This fire burned two thirds of the gorse shrubland at the site. Burnt stumps of what may be kōwhai were observed during the survey and it is likely that previous fires have led to the loss of flammable indigenous species at the site.

### 7.7 Climate change

NIWA climate change modelling predicts that the eastern South Island will have progressively hotter, dryer summers over the next 35 years due to global climate change

(NIWA 2021). This could potentially increase the incidence of fires and reduce the diversity of indigenous plant and animal species at the site due to more severe and prolonged summer droughts. Conversely, the increased frequency of extreme precipitation events, and associated high river flows, may lead to increased seasonal changes to the extent and morphology of the river and its braid plain, which could impact, either negatively or positively, the available habitat for indigenous flora and fauna. Addressing climate change implications for Coldstream 2 is beyond the scope of this restoration plan, although any actions to improve ecological resilience will likely confer improved capacity to accommodate climate change impacts, at least over short-medium time scales.

The following reports provide a starting point for longer-term climate change resilience planning for Coldstream 2:

- Macara G. *et al.* 2020: Climate change projections for the Canterbury Region. *NIWA Client Report No. 2019339WN*. Prepared for Environment Canterbury. 156 pp.
- Awatere S. *et al.* 2021: He huringa ahuarangi, he huringa ao: A changing climate, a changing world. 2021. *Manaaki Whenua Client Report*. Prepared by for Nga Pae o te Maramatanga. 61 pp.

## 8. MANAGEMENT ACTIONS

The following sections outline management actions<sup>1</sup> required to achieve the goals and objectives listed in Section 2. They encompass the entire site which is split into management units, and are presented in order of priority. Therefore, if funding is limited and time is constrained, actions can be scaled back or selected habitats prioritised. Management actions targeting dryland habitat restoration including weed control, and plantings to establish propagule supplies of indigenous species characteristic of braided river dryland habitats is the priority of this site. A workplan summarising the priority management actions, and areas, is presented in Appendix 6.

### 8.1 Undertake detailed biodiversity surveys

A detailed botanical survey is needed to map the vegetation and habitats, pest plant populations, and record indigenous and exotic plant species at the site. Restoration sites for mahinga kai species should also be identified. Likewise, indigenous avifauna and invertebrate surveys should be undertaken to inform future management decisions within the dryland mossfield/stonefields. Lizard surveys have recently been completed at the site (Frank 2021) and should be repeated again within the next five years. Freshwater fauna surveys, and assessments of freshwater mahinga kai restoration sites, should only be undertaken if sufficient stream habitat is located at the site.

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<sup>1</sup> Resource consent are required for some proposed actions within this site.

## 8.2 Explore options to further protect the dryland mossfield/stonefield habitat

The vast majority of the site occurs within the Rangitata Conservation Reserve, managed by the Department of Conservation under Section 23 of the 1977 Reserves Act. Consideration should be given to providing the dryland mossfield/stonefield with a higher level of protection to ensure the continued active management of the site. Additional protections could be achieved if the dryland mossfield/stonefield meets the criteria of a significant natural area in the Ashburton Council's District Plan (ADC 2021). Another protection mechanism which could be straightforward to implement is acknowledgment of the site in the next Conservation Management Strategy review.

Assessments to determine if the dryland mossfield/stonefields are remanent features or resulted from land use changes should be undertaken prior to exploring further protection options.

## 8.3 Identify management units

To facilitate the timely implementation of management actions we have broken the wider site into three management units (Figure 1). These management units could potentially be further subdivided in the future in line with available resources. Section 9 provides specific actions for each management unit. Section 12 provides a suggested four-year workplan to achieve these actions.

## 8.4 Redefine lease terms and area

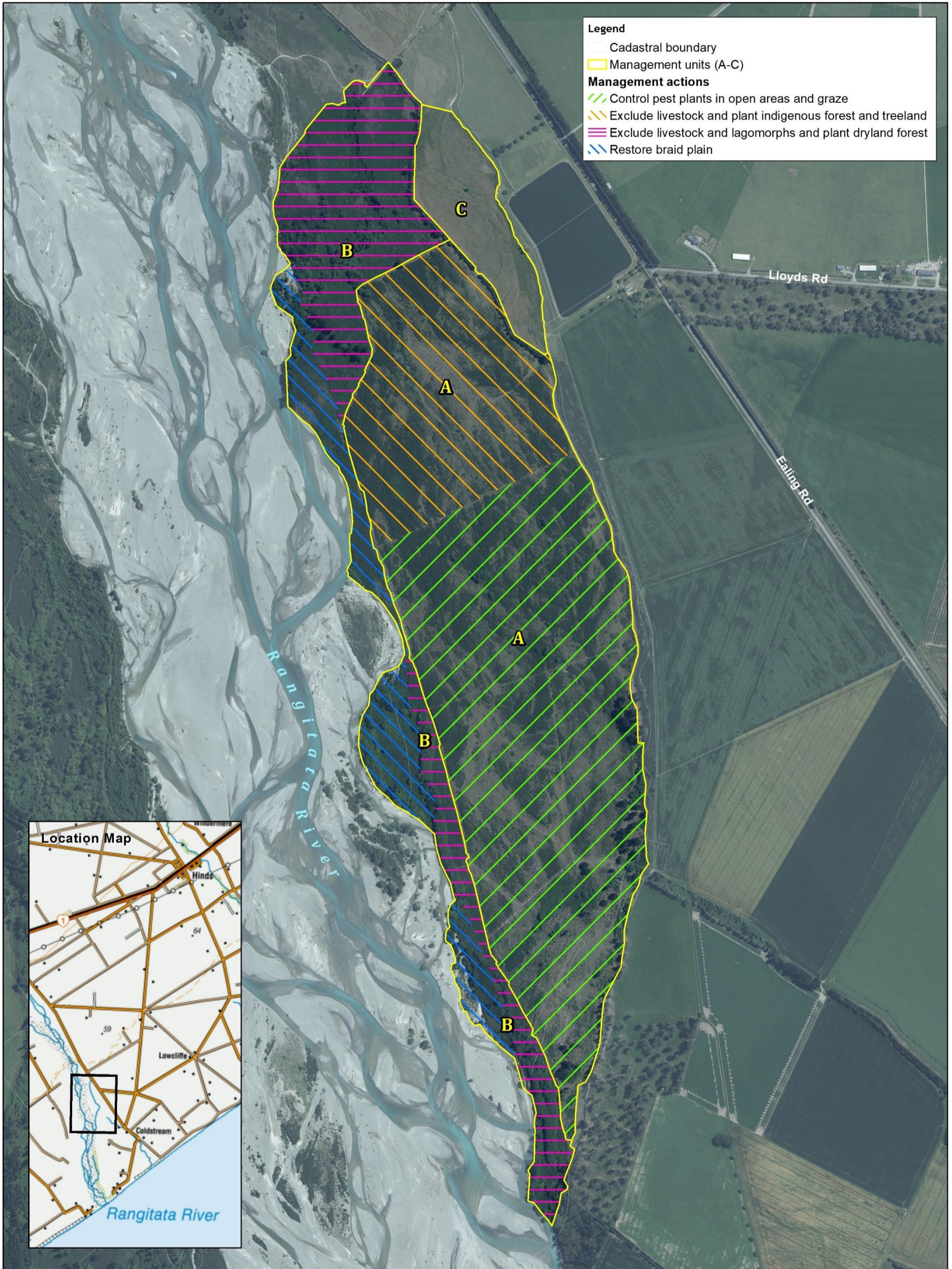
Restoration actions may not be compatible with existing lease terms and require renegotiation of terms and area. These terms could include specifying grazing regimes that promote the maintenance of dryland mossfield/stonefields.

## 8.5 Undertake targeted pest plant control across the wider site

Wilding conifers (primarily radiata pine; *Pinus radiata*) should be controlled throughout the site on an ongoing basis. Consideration should be given to removing the radiata pine shelter belt at the northeast end of the site to prevent this acting as a future seed source. Any other highly invasive tree species (i.e Grey willow; *Salix cinerea*) that are located at the site should be controlled on an ongoing basis.

## 8.6 Fence restoration areas to exclude livestock and lagomorphs

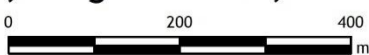
A section of the northern-most area of Management Unit A should be fenced to permanently exclude livestock and lagomorphs, and restoration plantings undertaken within these fence enclosures (see Figure 1 for potential area). The appropriate areas and scale of fencing should be determined after a detailed site survey. An alternative strategy would be to fence a greater number of small areas throughout Management Unit A. Areas of intact dryland mossfield/stonefields should be grazed to maintain biomass of exotic herbs and grasses at low levels and woody weeds cleared to maintain openness. The effects of livestock and lagomorph grazing should be compared between grazed and ungrazed areas of the dryland mossfield/stonefield (see Section 10).



**Figure 1. Management units and select management actions at Coldstream 2, Rangitata River, South Canterbury**

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 Format: A3

## 8.7 Manage exotic shrublands and undertake ecological restoration plantings within fence enclosures in the gravelfield/stonefield

Within the fenced enclosure, a matrix of open dryland mossfield/stonefield and indigenous dryland forest and treeland should be established (Figure 1). In more open areas of dryland mossfield/stonefield where exotic shrubs currently occur in low densities, all of the environmental pest plants, including seedlings and saplings, listed in Appendix 4, and any additional pest plant species, should be controlled on an ongoing basis to maintain open habitat and to protect the integrity of the most intact areas of dryland mossfield/stonefield. In dense areas of exotic shrubland, a tractor mounted mulcher could be used to cut tracks (c.2-3 metres wide) through the exotic shrublands to create sheltered planting sites for the establishment of indigenous dryland tree and shrub species. As these plantings mature, the surrounding pest plant species should be progressively controlled. In more scattered areas of exotic shrubland, indigenous plants should be planted amongst the exotic shrub species, and the shrublands controlled as the indigenous plants mature. A similar process should be implemented around areas of willow within the enclosure. The planting areas within dense exotic shrubland should focus on microsites where plant survival is likely to be greatest (i.e. areas that contain topsoil and occur in depressions), and should begin on the eastern side of the site so that the predominant winds (northeasterlies) facilitate seed dispersal. Once best practice methodologies are determined for restoration plantings at the site, Threatened and At Risk plant species could also be planted.

As the project progresses, additional enclosures should be constructed and the restoration areas extended within the site. The long-term goal should be to exclude livestock, undertake restoration plantings, and progressively control environmental pest plants throughout Management Unit A.

## 8.8 Maintain open areas of dryland gravelfield/stonefield in non-restoration areas in the medium term

Areas of open dryland mossfield/stonefield where restoration is not being implemented should continue to be grazed with sheep to reduce the biomass of herbaceous species. At a minimum, gorse and other exotic shrubs within open areas of dryland mossfield/stonefield should be controlled on an ongoing basis to prevent the establishment of dense exotic shrublands within these areas. However, ideally these shrublands should be progressively controlled over time to increase the overall areas of dryland mossfield/stonefield at the site.

## 8.9 Restore sections of braid plain within Management Unit B

Consideration could be given to returning the western-most sections of Management Unit B on the margin of the river to braid plain (Figure 1). This could be achieved by controlling the existing exotic vegetation, potentially by aerial spraying or then clearing the vegetation using earthmoving equipment, followed by mulching. Vegetation could either be buried, mechanically mulched, or transported off site, the appropriate option should be determined by the available budget and resource consent requirements. Subsequent winter flooding will restore the natural cover of shingle and sand over the area. Ongoing pest plant control would be needed here, and throughout the remainder of Management Unit B (see section 8.9 below) to maintain these areas free of exotic vegetation.



A land status check of any braid plain restoration areas would be required by LINZ before authority to undertake the works could be given.

#### 8.10 Undertake ecological restoration within the remaining areas of the site in the longer term

Ecological restoration could be undertaken in selected areas of Management Unit B (Figure 1). This would require that livestock (and ideally rabbits and hares) are excluded from the site and pest plants are controlled on an ongoing basis. Following confirmation that there are no Threatened and At Risk plant populations present at the site, the management units could be aurally sprayed and/or mechanically mulched prior to planting the species listed in Appendix 5 in a staged manner. A buffer of existing vegetation should be left on the margin of the braid plain to prevent erosion. In time, and as the restoration plantings mature, this buffer vegetation could be replaced with plantings of indigenous species.

Given the historic braid plain extended further north, and the upstream regions of Management Unit B could in the future be recaptured as braid plain by the river, as a result of future high-flow events, consideration could be given to not planting into parts of Management Unit B likely to be recaptured by the river, while still applying other management, such as aerial spraying and weed control, to the whole of the unit.

#### 8.11 Create additional lizard habitat

Artificial refugia (e.g. piles of stones or logs) could potentially be created for lizards within the dryland mossfield/stonefield if significant populations of southern grass skinks or other threatened lizards are located at the site. Many of the plants selected for indigenous revegetation of the dryland mossfield/stonefield are known to provide habitat for indigenous lizards. Lizards at the site should be monitored annually using artificial cover objects (ACOs) (Lettink 2012), or pitfall trapping. A qualified herpetologist should prepare a lizard monitoring plan prior to any vegetation clearance.

#### 8.12 Undertake pest animal control

Monitoring should be conducted at the site to determine the fauna values and pest animal species that are present, and the likely impacts these pests are having on indigenous fauna (see Section 10). Rabbit and hare proof fences should be incorporated into fence designs to protect restoration plantings. Possums should be controlled, for example by including Timms traps in pest control lines, if they impact plantings of palatable indigenous plant species as they mature and when fully established.

Low intensity predator control should be undertaken across the site to protect and enhance the skink population. This should target feral cats, mustelids, hedgehogs, rats and potentially mice. Feral cats would be targeted using modified Timms traps or Sentinels, and mustelids, hedgehogs and rats with DOC 200 series traps. Further rat control and mouse control could be implemented in specific localities if monitoring indicates they are problematic. Lizard monitoring will guide predator control design, and measure any lizard population increases resulting from predator control.

### 8.13 Develop a fire management plan

A fire management plan should be developed to guide management decisions to prevent and contain wildfires at the site. Balancing the role fire may play in maintaining dryland mossfield/stonefields against the risk to longer term ecological restoration goals will be key.

### 8.14 Develop site- and species-specific restoration plans

The results of the fauna and vegetation surveys should be used to inform detailed species- and site-specific restoration plans. The species-specific plans should target Threatened and At Risk species and should be guided by Department of Conservation translocation protocols and the tikanga of Te Rūnanga o Arowhenua.

### 8.15 Flood risk management

Consider opportunities to reduce the risk of flooding and erosion following changes in the river channel through braidplain restoration actions (woody weed removal) at sites surrounding the Coldstream 2 site.

## 9. SPECIFIC MANAGEMENT ACTIONS REQUIRED WITHIN THE MANAGEMENT UNITS

Table 1 outlines the specific management actions that are required in the three management units that have been identified at the site.

## 10. MONITORING

Monitoring should be regularly undertaken at the site to inform and improve the implementation of management actions and measure restoration success. The monitoring should be carried out throughout the four-year project and continued on an ongoing basis thereafter. Monitoring should be more frequent immediately after implementation of restoration, to track changes in response to the restoration. When the site reaches a restored state, monitoring frequency could be reduced.

### Photopoints

Photos, taken at specific points and at set timeframes, are an efficient way to monitor gross changes in vegetation composition and structure within a defined viewpoint. It is recommended that at least 15 photopoints are established at the site. The location of each photopoint should be recorded with a handheld global positioning system (GPS). A compass should be used to gauge a bearing to the center of the frame of the photopoint. The photos should then be printed to provide a reference for future revisits. The photopoints should be resampled every year in sites where frequent management actions are occurring (e.g. ongoing pest plant control operations).

Table 1: Management actions required within each of the four management units at the Coldstream 2 site.

Management Unit	Size (ha)	Current Vegetation and Habitat Type	Intended Vegetation and Habitat Type	Suggested Management Actions
A, B	111.3	Gorse shrubland, gorse-Scotch broom-blackberry shrubland, mossfield-lichenfield-stonefield, exotic conifer treeland, exotic grassland, stonefield (riverbed)	Indigenous dryland forest and treeland, mossfield-lichenfield-stonefield riparian forest, flaxland, reedland and sedgeland, river braid plain	<ul style="list-style-type: none"> <li>• Undertake detailed botanical survey.</li> <li>• Complete invertebrate surveys.</li> <li>• Assess the extent of freshwater habitat within the management units.</li> <li>• Monitor for and undertake pest animal control to protect lizard populations (see Section 10).</li> <li>• Undertake pest animal control to protect other values.</li> <li>• Develop species-specific management plans if populations of Threatened or At Risk species are located.</li> <li>• Prepare fire management plan.</li> <li>• Undertake assessment to determine status of dryland mossfield/stonefields</li> <li>• Undertake assessment to elevate the legal protection status of the dryland mossfield/stonefields</li> <li>• Establish permanent vegetation monitoring plots to assess the effects of livestock and lagomorph grazing on the dryland mossfield/stonefields vegetation.</li> <li>• Control wilding conifers and other invasive trees on an ongoing basis throughout the management unit.</li> <li>• Redefine lease terms and area with current leaseholder.</li> <li>• Assess opportunities to undertake woody weed control on adjacent side of the Rangitata river to lesson flood and erosion risk.</li> </ul>
A	77.6	Gorse shrubland, gorse-Scotch broom-blackberry shrubland, mossfield-lichenfield-stonefield, exotic conifer treeland	Indigenous dryland forest and treeland, mossfield-lichenfield-stonefield	<ul style="list-style-type: none"> <li>• Construct livestock and lagomorph proof exclusion fences.</li> <li>• Mulch tracks through areas of dense exotic shrubland and control regrowth on an ongoing basis.</li> <li>• Plant indigenous dryland species within livestock and lagomorph proof enclosures (see Appendix 5).</li> <li>• Progressively control target environmental pest plants within fence enclosure.</li> <li>• Establish firebreaks around restoration areas.</li> <li>• Continue to graze unmanaged areas of the unit.</li> <li>• Progressively control exotic shrubs in mossfield-lichenfield-stonefield to maintain extent.</li> </ul>
B	33.7	Exotic conifer forest (shelterbelt) and treeland, crack willow forest and treeland, gorse shrubland, gorse-Scotch broom-blackberry shrubland, stonefield (riverbed)	Indigenous dryland forest and scrub, riparian forest, flaxland, reedland and sedgeland, river braid plain	<ul style="list-style-type: none"> <li>• Control pest plants in areas where braid plain restoration will take place and undertake works to remove the vegetation. The appropriate option should be determined by available budget and resource consent requirements but could include burying, mechanically mulch or transport the material off sites.</li> </ul>

Management Unit	Size (ha)	Current Vegetation and Habitat Type	Intended Vegetation and Habitat Type	Suggested Management Actions
				<ul style="list-style-type: none"> <li>Control wilding conifers and other invasive trees on an ongoing basis.</li> <li>Fence the margins of the management units that abut grazing land.</li> <li>Carry out a land status check with LINZ prior to braid plain restoration.</li> </ul> <p><u>Management Actions to be Implemented in the Longer Term</u></p> <ul style="list-style-type: none"> <li>Subject to a feasibility assessment, spray in the Mid-autumn in advance of undertaking restoration plantings.</li> <li>Undertake staged mechanical mulching of shrublands prior to planting.</li> <li>Plant drier areas with indigenous forest and scrub species that are capable of surviving seasonal drought (see Appendix 5).</li> <li>Plant riparian margins with indigenous riparian forest, harakeke, and indigenous sedges and rushes (see Appendix 5).</li> <li>Undertake pest plant control around restoration plantings until canopy closure occurs (canopy closure could occur in four to six years, but will depend on site characteristics).</li> <li>Incorporate mahinga kai species within plantings, where possible.</li> <li>Undertake introductions of freshwater mahinga kai species (e.g. freshwater crayfish; <i>Paranephrops zealandicus</i>) if there is sufficient habitat.</li> <li>Monitor for and undertake pest animal control, if needed (see Section 10).</li> </ul>
C	7.4	Exotic grassland	Maintain as exotic grassland	<ul style="list-style-type: none"> <li>Continue livestock grazing within unit.</li> <li>Control pest plants as needed.</li> <li>Mature kōwhai is a potential seed source for restoration plantings.</li> </ul>
<b>Total</b>	<b>118.7</b>			

### Effects of Livestock Grazing

Permanent vegetation monitoring plots should be established within the gravelfield/stonefield in the fence enclosure and the unfenced, grazed area of the management unit to compare the effects of livestock and lagomorph browse. Additional fence units could be established within the grazed area of the unit to only exclude livestock, thereby determining the effect that lagomorphs have on vegetation cover. A minimum of fifteen 10 × 10 metre vegetation plots should be established within each treatment. The plots should be remeasured every two years initially for the first six years following installation, and then every four to five years thereafter.

### Pest Plants and Restoration Plantings

Monitoring operations should be undertaken at least every three months during the growing season to track the proportions of pest plants killed via control work and the survival rates of restoration plantings. Walk through transects should be established through restoration areas to provide ongoing monitoring of management operations. The results of this monitoring should be used to improve management decisions regarding factors such as herbicide choice and the density and species selection of future restoration plantings.

### Pest Animals

Rabbits, hares and possums should be monitored prior to and after restoration plantings are established. All pest monitoring should follow the best practice guidelines provided on the Bionet website (<https://www.bionet.nz/library/>).

The outcome of predator control to protect lizards should be monitored using tracking tunnels (Gillies and Williams 2013). Trail camera monitoring may also be necessary if there is a high abundance of feral cats at the site, as determined by cat captures in kill traps.

### Natural and Reintroduced Populations of Threatened Species

All populations of naturally occurring and reintroduced threatened species should be regularly monitored to build a better understanding of their habitat requirements, determine the limitations to restoration success, and identify future management actions. The monitoring regime will vary by species and should be undertaken by biologists who have experience working with the target species.

## 11. CONSTRAINTS

The successful ecological restoration of the Coldstream 2 site is potentially constrained by a number of factors. These constraints, and their potential solutions, are outlined in Table 2.

Table 2: Potential constraints and solutions for the ecological restoration of the Coldstream 2 site.

Potential Constraints	Potential Solutions
Lack of ongoing funding beyond the four-year timeframe	<ul style="list-style-type: none"> <li>• Begin applying for further funding within the first two years of the project.</li> <li>• Hire a dedicated project manager to successfully implement the project.</li> <li>• Widely publicise the work of the project to build a profile and community support.</li> </ul>
Ongoing environmental pest plant invasion	<ul style="list-style-type: none"> <li>• Undertake ongoing pest plant control.</li> <li>• Ensure maintenance teams are experienced and follow best practice protocols.</li> <li>• Where feasible, undertake restoration in the wider area.</li> <li>• Undertake ongoing pest plant monitoring to improve the efficiency and effectiveness of control efforts (see Section 10).</li> </ul>
Failure of restoration plantings	<ul style="list-style-type: none"> <li>• Only contract reputable native plant nurseries who have a track record of growing high-quality plants.</li> <li>• Ensure planting teams are experienced and follow best practice protocols.</li> <li>• Undertake regular maintenance of plantings in the first year after planting.</li> <li>• Employ an adaptive management approach by undertaking regular monitoring to inform ongoing restoration actions (see Section 10).</li> </ul>
Failure of species reintroductions	<ul style="list-style-type: none"> <li>• Seek the advice of technical experts to ensure reintroductions follow best practice guidelines.</li> <li>• Only undertake species reintroductions in habitats that are sufficiently intact and have high ecological resiliency.</li> <li>• Undertake regular monitoring following species reintroductions to determine ongoing management actions (see Section 10).</li> </ul>
Habitat changes due to elevated soil nutrient and organic matter inputs in dryland mossfield/stonefield	<ul style="list-style-type: none"> <li>• Control leguminous shrubs within dryland mossfield/stonefields.</li> <li>• Prevent run off from surrounding dairy farms from entering the site.</li> <li>• Continue to graze the dryland mossfield/stonefields with sheep to suppress the growth of legumes and exotic herbs and grasses.</li> <li>• Do not graze cattle within the site.</li> </ul>
Fire	<ul style="list-style-type: none"> <li>• Maintain firebreaks around restoration areas.</li> <li>• Develop a fire management plan for the site.</li> <li>• Continue livestock grazing in unmanaged areas to reduce fuel loads.</li> <li>• Control flammable exotic plant species (principally gorse and Scotch broom) throughout the site.</li> </ul>
Changes in course of river/ flooding and erosion	<ul style="list-style-type: none"> <li>• Maintain a buffer of existing vegetation along the margins of the braid plain.</li> <li>• Where possible, ensure the upstream areas of the river are maintained free of large woody debris.</li> <li>• Consider woody weed control and braidplain restoration on adjacent bank of the Rangitata River to lessen flood and erosion risk.</li> <li>• Concentrate planting in areas of lower flood and erosion risk.</li> </ul>

Potential Constraints	Potential Solutions
	<ul style="list-style-type: none"> <li>• Acknowledge that dynamism is a natural process with inherent flood and erosion risk.</li> <li>• Adopt an adaptive management approach to landscape changes.</li> </ul>
Climate change	<ul style="list-style-type: none"> <li>• Implement the management actions outlined in this report.</li> <li>• Adapt management actions (e.g. restoration species) in anticipation of future changes in climate.</li> <li>• Transition habitats in response to climate changes (e.g. maintain an open, largely unvegetated dryland mossfield/stonefields).</li> </ul>

## 12. TIMELINE AND ESTIMATED COSTS FOR IMPLEMENTATION OF MANAGEMENT ACTIONS

The following workplan outlines the timeline and indicative costs for management actions within Management Units A and B (Table 3). The costings assume that restoration plantings will be completed in Management Unit A within Year 1, initial pest plant control in Management Unit B will be undertaken via helicopter spraying, and that restoration plantings within Management Unit B are staggered over four years. The 12 month period for the implementation of management actions within the four years begins in November 2021.

Table 3: Timeline and indicative costs for the implementation of ecological restoration actions at the Coldstream 2 site.

Management Unit	Management Action	Timing	Price Estimate
<b>Year 1</b>			
A and B	Detailed vegetation and habitat survey, and bird survey (principally focussed on Management Unit A)	November 2021-May 2022	\$10,000
	Invertebrate survey (principally focussed on Management Unit A)	November 2021-April 2022	\$6,000
	Freshwater fauna survey (if sufficient freshwater habitats occur at the site)	November 2021-April 2022	\$7,000
	Establish photopoints where ecological restoration will occur	November 2021-May 2022	\$1,500
	Order eco-sourced plants and planting materials (plant guards etc.)	November 2021	\$400,000
	Order infill plants (c.10% mortality)	November 2022	\$40,000
	Redefine lease terms and area with current leaseholder	As appropriate	Cost to be determined
	Undertake dryland mossfield /stonefields assessments	As appropriate	Cost to be determined
	Assess options for braidplain restoration beyond Coldstream site to reduce erosion risk.	As appropriate	Cost to be determined
A	Install and undertake ongoing pest animal control for lizard protection	Throughout the year	\$23,000
	Fence enclosure installation	November 2021 to May 2022	\$19,000
	Establish permanent vegetation monitoring plots in grazed and ungrazed areas of the unit	March 2022	\$5,000

Management Unit	Management Action	Timing	Price Estimate
	Control environmental pest plants within enclosure and wilding pines and other invasive trees throughout unit	March 2022	\$80,000
	Mulch tracks through dense areas of exotic shrublands	April 2022	\$8,000
	Prepare planting sites	April 2022	\$29,000
	Planting	May and June 2022	\$130,000
	Undertake assessment to elevate the legal protection status of the gravelfield/stonefield	Ongoing	Cost to be determined by Department of Conservation
B	Install or upgrade perimeter fences (as required)	November 2021-May 2022	Cost dependent on extent of fencing required
	Aerially spray pest plants within management unit	March 2022	\$25,000
	Mechanically mulch exotic shrublands in restoration planting areas (section of unit only)	April 2022	\$10,000
	Clear vegetation within braid plain restoration areas	May 2022	\$25,000
	Plant a section of the management unit	May and June 2022	\$64,500
	Carry out a land status check for areas of braid plain restoration.	November 2021	Cost to be determined
<b>Year 2</b>			
A	Undertake ongoing pest animal control for lizard protection	Throughout the year	\$18,000
A and B	Remeasure photopoints	November 2022-May 2023	\$1000
	Pest plant control within restoration sites (including within firebreaks)	Two times: November 2022, March 2023	\$40,000
	Infill planting	May and June 2023	\$15,500
B	Order eco-sourced plants and planting materials (plant guards etc.)	November 2022	\$70,000
	Mechanically mulch exotic shrublands in restoration planting areas (section of unit only)	March 2023	\$10,000
	Undertake site preparation in advance of planting	April 2023	\$14,000
	Plant a section of the management unit	May and June 2023	\$25,000
<b>Year 3</b>			
A	Undertake ongoing pest animal control for lizard protection	Throughout the year	\$18,000
A and B	Remeasure photopoints	November 2023-May 2024	\$1000
	Pest plant control within restoration sites (including within firebreaks)	Two times: November 2023, March 2024	\$30,000
B	Order eco-sourced plants and planting materials (plant guards etc.)	November 2023	\$70,000
	Control pest plants within braid plain restoration areas	March 2024	\$50,000
	Mechanically mulch exotic shrublands in restoration planting areas (section of unit only)	April 2024	\$10,000
	Undertake site preparation in advance of planting	April 2024	\$14,000
	Plant a section of the management unit	May and June 2024	\$25,000
	Infill planting of Year 2 planting sites	May and June 2024	\$3,500
	Order infill plants (c.10% mortality)	November 2024	\$6,800
<b>Year 4</b>			
A	Undertake ongoing pest animal control for lizard protection	Throughout the year	\$18,000



Management Unit	Management Action	Timing	Price Estimate
A and B	Remeasure photopoints	November 2024-May 2025	\$1000
	Pest plant control within restoration sites (including within firebreaks)	Two times: November 2024, March 2025	\$30,000
	Conservation Management Strategy review	As occurs	Negligible
B	Mechanically mulch exotic shrublands in restoration planting areas (section of unit only)	April 2025	\$10,000
	Undertake site preparation in advance of planting	April 2025	\$14,000
	Plant a section of the management unit	May and June 2025	\$25,500
	Infill planting of Year 3 planting sites	May and June 2025	\$3,500
<b>Total</b>			<b>\$1,406,800</b>

### 13. CONCLUSIONS

The Coldstream 2 site contains dryland habitats that are of high ecological value due to their relative scarcity on the Canterbury Plains. The primary threats to these habitats are from pest plants, fire, pest animals, livestock grazing, and climate change. Although the extant indigenous vegetation communities are in a highly degraded state, the site provides excellent opportunities for the restoration of now rare indigenous vegetation and habitat types. The site also lends itself to the enhancement of lizard populations.

In order to meet the Rangitata Steering Groups overarching goals of improving species recovery, habitat enhancement, and identification of opportunities for restoring mahinga kai resources at the Coldstream 2 site, ecological values, threats and management actions have been identified. These include creating livestock and lagomorph proof enclosures in which dryland tree and shrub species can be planted, controlling pest plants and undertaking restoration plantings in other areas of the site, restoring braid plain habitat and undertaking predator control to enhance lizard populations. Implementing these management actions will greatly enhance the ecological integrity and mauri of this ecologically important site.

### ACKNOWLEDGMENTS

Brad Edwards (Department of Conservation/ Te Papa Atawhai) provided client liaison and background information on the values, threats and management opportunities for each site. Additional information was provided by Karl Jackson (Te Rūnanga o Arowhenua), Michael McMillan (Aoraki Environmental Consultancy, Te Rūnanga o Arowhenua), Angela Christensen (Fish and Game), Jayde Couper (Fish and Game), Greg Stanley (Environment Canterbury), David Owen (Environment Canterbury), Paul Eddy (Environment Canterbury), Andrew Grant (Department of Conservation/Te Papa Atawhai), and Ellery Mayence (Department of Conservation/ Te Papa Atawhai).

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## VEGETATION AND HABITAT TYPES RECORDED AT COLDSTREAM 2, RANGITATA RIVER

The vegetation and habitat types recorded at the Coldstream 2 site during the July 2021 site visit are listed below. The distribution of these vegetation and habitat types at the site is illustrated in Figure 2.

### 1. Exotic conifer forest (shelterbelt) and treeland

A pine shelterbelt (most probably radiata pine) is located on the southwest boundary of the large exotic grassland at the site. Scattered areas of pine (again, most likely radiata pine) treeland occur throughout the site.

### 2. Crack willow forest and treeland

Areas of willow forest and treeland that contain crack willow (*Salix xfragilis*) and possibly also grey willow (*S. cinerea*) likely occur along streams and springs primarily on the western side of the site. Poplars (*Populus* sp.) may also occur within the larger areas of forest. It is likely that these areas of forest and treeland contain an understorey of exotic shrub and liane species that include blackberry, gorse, old man's beard (*Clematis vitalba*) and Scotch broom.

### 3. Gorse shrubland

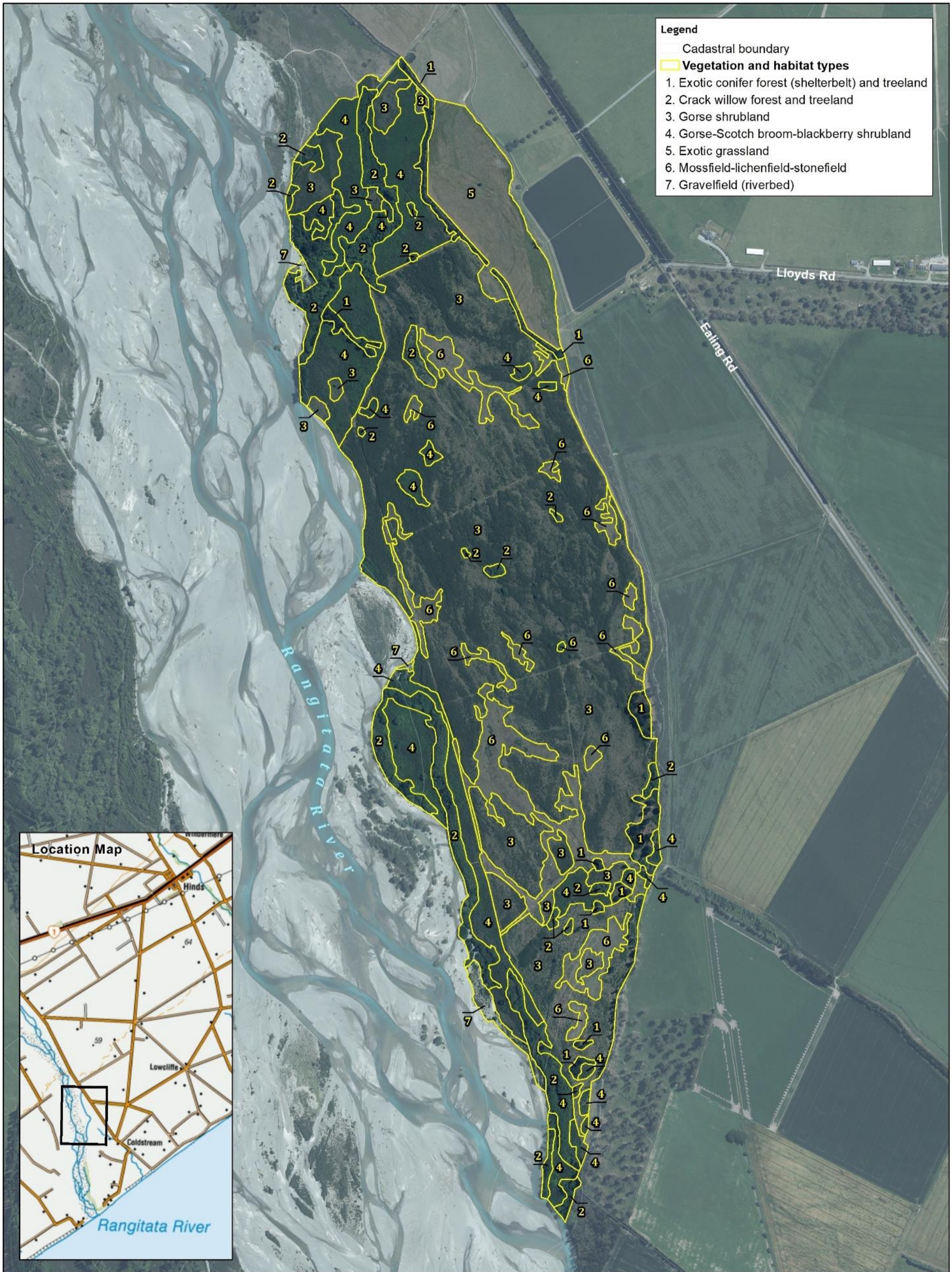
Extensive areas of shrubland that primarily contain gorse occur throughout the site. The density of the shrublands varies across the site, forming monotypic stands in places and mixed areas of gorse, mossfield, lichenfield and gravelfield/stonefield in others. Scattered crack willows and pine trees occur throughout the areas of shrubland.

### 4. Gorse-Scotch broom-blackberry shrubland

Large areas of shrubland that likely contain gorse, Scotch broom and blackberry primarily occur in the north and west of the site. The areas of this vegetation type that were visited in the north of the site contained scattered indigenous plant species such as tī kōuka (cabbage tree, *Cordyline australis*). It is likely that additional indigenous species such as karamū (*Coprosma robusta*) and kōhūhū (*Pittosporum tenuifolium*) are also present.

### 5. Exotic grassland

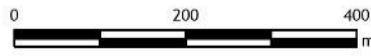
An area of former riverbed in the northeast corner of the site has been developed as exotic grassland (pasture) for livestock grazing. This area was not surveyed in detail during the site visit, but is likely to contain species such as ryegrass (*Lolium perenne*), sweet vernal (*Anthoxanthum odoratum*) and white clover (*Trifolium repens*). One kōwhai was seen during the survey.



- Legend**
- Cadastral boundary
  - ▭ Vegetation and habitat types
  - 1. Exotic conifer forest (shelterbelt) and treeland
  - 2. Crack willow forest and treeland
  - 3. Gorse shrubland
  - 4. Gorse-Scotch broom-blackberry shrubland
  - 5. Exotic grassland
  - 6. Mossfield-lichenfield-stonefield
  - 7. Gravelfield (riverbed)



**Figure 2. Vegetation and habitats at Coldstream 2, Rangitata River, South Canterbury**



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Scale: 1:8,000  
 Date: 24/09/2021  
 Cartographer: FM  
 Format: A3

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Report: 5920  
 Client: Department of Conservation  
 Ref: 07 0525  
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## 6. Mossfield-lichenfield and stonefield

Areas of former riverbed that contain stones, mosses and lichens are scattered through the areas of gorse shrubland at the site. These areas of mossfield-lichenfield and stonefield contain scattered gorse as well as indigenous and exotic grasses and herbs that include catsear (*Hypochaeris radicata*), creeping pōhuehue (*Muehlenbeckia axillaris*), white clover, sweet vernal and Yorkshire fog (*Holcus lanatus*). Mosses that are present include juniper haircap moss (*Polystrichum juniperinum*), *Racomitrium* spp. and *Rosulabryum* spp. Dryland mossfield/stonefields may be natural features of alluvial terraces, particularly on accumulations of coarse stone with limited water holding capacity beneath a thin organic crust. However, they may also be maintained by browsing and grazing pressure, if it is preventing woody vegetation succession.

## 7. Stonefield (riverbed)

Small areas of riverbed are located on the western boundary of the site. These areas appear to have been colonised by shrubs that are likely to be gorse and Scotch broom.

## AVIFAUNA SPECIES RECORDED ON EBIRD NEAR THE COLDSTREAM 2 SITE, RANGITATA RIVER

Scientific Name	Common Name	Threat Classification <sup>1</sup>
<b>Indigenous</b>		
<i>Anas gracilis</i>	Grey teal	Not Threatened
<i>Anas rhynchotis</i>	Australasian shoveler	Not Threatened
<i>Aythya novaeseelandiae</i>	New Zealand scaup	Not Threatened
<i>Charadrius bicinctus bicinctus</i>	Banded dotterel	At Risk-Declining
<i>Chlidonias albostratus</i>	Black-fronted tern	Threatened-Nationally Endangered
<i>Circus approximans</i>	Swamp harrier	Not Threatened
<i>Cygnus atratus</i>	Black swan	Not Threatened
<i>Egretta novaehollandiae</i>	White-faced heron	Not Threatened
<i>Haematopus finschi</i>	South Island pied oystercatcher	At Risk – Declining
<i>Haematopus unicolor</i>	Variable oystercatcher	At Risk-Recovering
<i>Himantopus himantopus leucocephalus</i>	Pied stilt	Not Threatened
<i>Hirundo neoxena neoxena</i>	Welcome swallow	Not Threatened
<i>Hydroprogne caspia</i>	Caspian tern	Threatened-Nationally Vulnerable
<i>Larus bulleri</i>	Black-billed gull	At Risk-Declining
<i>Larus dominicanus dominicanus</i>	Southern black-backed gull	Not Threatened
<i>Larus novaehollandiae scopulinus</i>	Red-billed gull	At Risk-Declining
<i>Morus serrator</i>	Australasian gannet	Not Threatened
<i>Phalacrocorax carbo novaehollandiae</i>	Black shag	At Risk-Relict
<i>Phalacrocorax melanoleucos brevirostris</i>	Little shag	At Risk-Relict
<i>Phalacrocorax melanoleucos melanoleucos</i>	Little pied shag	Non-resident Native-Vagrant
<i>Phalacrocorax varius varius</i>	Pied shag	At Risk-Recovering
<i>Porphyrio melanotus</i>	Pūkeko	Not Threatened
<i>Rhipidura fuliginosa fuliginosa</i>	South Island fantail	Not Threatened
<i>Sterna striata striata</i>	White-fronted tern	At Risk-Declining
<i>Tadorna variegata</i>	Paradise shelduck	Not Threatened
<i>Todiramphus sanctus vagans</i>	New Zealand kingfisher	Not Threatened
<i>Vanellus miles novaehollandiae</i>	Spur-winged plover	Not Threatened
<i>Zosterops lateralis lateralis</i>	Silvereye	Not Threatened
<b>Exotic</b>		
<i>Alauda arvensis</i>	Skylark	Introduced and naturalised
<i>Anas platyrhynchos</i>	Mallard	Introduced and Naturalised
<i>Branta canadensis</i>	Canada goose	Introduced and naturalised
<i>Carduelis carduelis</i>	Goldfinch	Introduced and naturalised
<i>Carduelis chloris</i>	Greenfinch	Introduced and naturalised
<i>Columba livia</i>	Rock pigeon	Introduced and naturalised
<i>Cygnus olor</i>	Mute swan	Introduced and naturalised
<i>Emberiza citronella</i>	Yellowhammer	Introduced and naturalised

<sup>1</sup> As per Robertson *et al.* (2021).

<b>Scientific Name</b>	<b>Common Name</b>	<b>Threat Classification<sup>1</sup></b>
<i>Fringilla coelebs</i>	Chaffinch	Introduced and naturalised
<i>Gymnorhina tibicen</i>	Australian magpie	Introduced and naturalised
<i>Passer domesticus</i>	House sparrow	Introduced and naturalised
<i>Prunella modularis</i>	Dunnock	Introduced and naturalised
<i>Sturnus vulgaris</i>	Starling	Introduced and naturalised
<i>Turdus merula</i>	Blackbird	Introduced and naturalised
<i>Turdus philomelos</i>	Song thrush	Introduced and naturalised

## POTENTIAL MAHINGA KAI RESOURCES THAT COULD BE ESTABLISHED AT THE COLDSTREAM 2 SITE, RANGITATA RIVER

Species	Common Name	Threat Status	Mahinga Kai Resource
<b>Plant</b>			
<i>Cordyline australis</i>	Tī kōuka, cabbage tree	Not Threatened	Numerous medicinal, food, fibre uses <sup>1</sup> .
<i>Coriaria</i> spp.	Tutu	Not Threatened	Used in medicine, beverages, dyes and crafts. Almost all parts of plant are toxic <sup>1</sup> .
<i>Nasturtium officinale</i>	Kōwhitiwhiti, watercress	Introduced and Naturalised	Edible leaves, used medicinally for headaches <sup>1</sup> .
<i>Phormium tenax</i>	Harakeke, flax	Not Threatened	Numerous medicinal, food, fibre, dyes, and construction uses <sup>1</sup> .
<i>Pteridium esculentum</i>	Rārāhu, bracken	Not Threatened	Numerous medicinal, food, hunting, and construction uses. Young fronds contain carcinogens <sup>1</sup> .
<i>Typha orientalis</i>	Raupō, bullrush	Not Threatened	Numerous medicinal, food, hunting, and construction uses <sup>1</sup> .

1. Further information at (requires a search of individual plant species):  
<https://maoriplantuse.landcareresearch.co.nz/WebForms/default.aspx>



## ENVIRONMENTAL PEST PLANTS RECORDED AT THE COLDSTREAM 2 SITE, RANGITATA RIVER

Scientific Name	Common Name	Status in the RPMP <sup>1</sup>
<i>Cytisus scoparius</i>	Scotch broom	Sustained Control
<i>Lupinus arboreus</i>	Tree lupin	Not listed
<i>Pinus radiata</i>	Radiata pine	Not listed
<i>Rubus fruticosus</i>	Blackberry	Organism of Interest
<i>Salix xfragilis</i>	Crack willow	Not listed
<i>Sedum acre</i>	Stonecrop	Not listed
<i>Ulex europaeus</i>	Gorse	Sustained Control

1 As outlined in the Canterbury Regional Pest Management Plan 2018-2038.

## GUIDELINES FOR PLANTING AND MAINTAINING INDIGENOUS PLANT SPECIES AT THE COLDSTREAM 2 SITE, RANGITATA RIVER

### OVERVIEW

The following section provides an overview of the management actions required for the successful planting and establishment of indigenous species at the Coldstream 2 site.

### SPECIES SOURCES AND SELECTION

- All indigenous plant species should occur naturally in similar sites within the Low Plains Ecological District.
- All plants should be sourced from the Low Plains Ecological District genetic stock or from nearby ecological districts and should generally have been grown from seed to maximise potential genetic diversity.
- A range of indigenous species with different attributes were identified for the plantings (listed in Table 4-7). These include:
  - Drought tolerant trees, shrubs and grasses that naturally occur on the Canterbury Plains.
  - Raupō, harakake and a range of sedges and rushes for planting along damp riparian margins.
  - Mahinga kai species.
  - Any Threatened or At-Risk species need to be planted within livestock and rabbit/hare proof fences. Threatened species to be planted include *Olearia fimbriata* (Threatened – Nationally Vulnerable), dwarf broom (*Carmichaelia crassicaulis* Threatened – Nationally Vulnerable) and plains olearia (*Olearia adenocarpa* Threatened – Nationally Vulnerable). At Risk – Declining species for this project include: matagouri/tūmatakuru and *Coprosma brunnea*.
  - Vigorous indigenous species that will quickly colonise the planting areas within Management Units B (e.g. toatoa, *Haloragis erecta*; karamū; and koromiko, *Veronica salicifolia*).
  - Fleshy-fruited species, to provide food for indigenous fauna and to facilitate their dispersal by birds within Management Units B.

### PLANT GRADES

- Planter bag (PB) plant grades (ideally 2/3) should preferably be used for most of the plantings as their stature and robustness reduces their vulnerability to light or incidental browsing by herbivorous animal pests (e.g. rabbits, possums), and they are more resilient to frosts and drought.
- PB grade plants should also be used for enrichment plantings.
- Where pre-planting site preparation and post-planting monitoring and maintenance are carried out to a high standard, plants in root trainers (RTs) can be used instead of larger (more costly) plants in individual PBs.

Table 4: Indigenous plant species to be planted within dense exotic shrublands in Management Unit A, Coldstream 2, Rangitata River.

Scientific Name	Common Name	Conservation Status	Spacing (m)	Percentage (%)	Quantity per Hectare
<i>Coprosma crassifolia</i>	Thick-leaved coprosma, mikimiki	Not Threatened	1	5	500
<i>Coprosma propinqua</i>	Mingimingi, mikimiki	Not Threatened	1	5	500
<i>Cordyline australis</i> <sup>1</sup>	Cabbage tree, tī kōuka	Not Threatened	1.5	5	222
<i>Corokia cotoneaster</i>	Korokio	Not Threatened	1.5	5	222
<i>Helichrysum lanceolatum</i>	Ninia	Not Threatened	1.5	5	222
<i>Hoheria angustifolia</i>	Narrow-leaved lacebark, houhere	Not Threatened	1.5	5	222
<i>Kunzea robusta</i>	Kānuka, rawirinui, kopuka	Threatened – Nationally Vulnerable	1	20	2,000
<i>Muehlenbeckia complexa</i>	Scrub pōhuehue, wire vine	Not Threatened	1	5	500
<i>Myrsine divaricata</i>	Weeping matipo, weeping māpou	Not Threatened	1.5	5	222
<i>Olearia lineata</i>		At Risk – Declining	1.5	5	222
<i>Olearia paniculata</i>	Akiraho	Not Threatened	1.5	5	222
<i>Pennantia corymbosa</i>	Kaikōmako, ducks foot	Not Threatened	1.5	5	222
<i>Pittosporum tenuifolium</i> <sup>1</sup>	Kōhūhū, black matipo	Not Threatened	1.5	5	222
<i>Pseudopanax crassifolius</i>	Lancewood, horoeka	Not Threatened	1.5	5	222
<i>Rubus schmidelloides</i> var. <i>subpauperatus</i> or <i>Rubus squarrosus</i>	Bush lawyer, tātārāmoa Leafless lawyer, yellow-prickled lawyer	Not Threatened	1.5	5	222
<i>Sophora microphylla</i>	Small-leaved kōwhai	Not Threatened	1.5	10	445
<b>Total</b>				<b>100</b>	<b>6,387</b>

<sup>1</sup> Plant in landscape depressions and sheltered sites where summer soil moisture levels are likely to increase plant survival rates.

Table 5: Indigenous plant species to be planted in open dryland areas within Management Unit A, Coldstream 2, Rangitata River.

Scientific Name	Common Name	Conservation Status	Spacing (m)	Percentage (%)	Quantity per Hectare
<i>Carex comans</i>		Not Threatened	1	2	200
<i>Carmichaelia australis</i>	Native broom, common broom	Not Threatened	1	10	1,000
<i>Carmichaelia crassicaulis</i>	Coral broom	Threatened –Nationally Vulnerable	1	2	200
<i>Coprosma brunnea</i>		At Risk – Declining	1.5	2	89
<i>Coprosma intertexta</i>		At Risk – Declining	1.5	5	222
<i>Coprosma propinqua</i>	Mingimingi, mikimiki	Not Threatened	1.5	15	667
<i>Discaria toumatou</i>	Matagouri, tūmatakuru	At Risk – Declining	1.5	15	667
<i>Festuca novae-zelandiae</i>	Fescue tussock, hard tussock	Not Threatened	1	10	1,000
<i>Melicytus alpinus</i>	Porcupine shrub	Not Threatened	2	6	150
<i>Muehlenbeckia astonii</i>	Shrubby tororaro, wiggywig	Not Threatened	2	2	50
<i>Olearia adenocarpa</i>	Plains olearia	Threatened – Nationally Critical	1.5	2	89
<i>Olearia fimbriata</i>		Threatened –Nationally Vulnerable	1.5	2	89
<i>Ozothamnus leptophyllus</i>	Tauhinu, cottonhead	Threatened –Nationally Vulnerable	1.5	10	445
<i>Poa cita</i>	Silver tussock, wī	Not Threatened	1.5	15	667
<i>Poa colensoi</i>	Blue tussock	Not Threatened	1	2	200
<b>Total</b>				<b>100</b>	<b>5,735</b>

Table 6: Indigenous plant species to be planted in dryland areas of Management Unit B, Coldstream 2, Rangitata River.

Scientific Name	Common Name	Conservation Status	Spacing (m)	Percentage (%)	Quantity per Hectare
<i>Anemanthele lessoniana</i>	Wind grass	At Risk – Relict	1	1	100
<i>Coprosma crassifolia</i>	Thick-leaved coprosma, mikimiki	Not Threatened	1	2	200
<i>Coprosma lucida</i>	Karamū	Not Threatened	1	2	200
<i>Coprosma propinqua</i>	Mingimingi, mikimiki	Not Threatened	1	3	300
<i>Coprosma robusta</i>	Karamū	Not Threatened	1	2	200
<i>Cordyline australis</i>	Cabbage tree, tī kōuka	Not Threatened	2	3	75
<i>Elaeocarpus dentatus</i>	Hīnau	Not Threatened	1.5	2	89
<i>Griselinia littoralis</i>	Broadleaf, kāpuka	Not Threatened	1.5	3	133
<i>Hoheria angustifolia</i>	Narrow-leaved lacebark, houhere	Not Threatened	1.5	3	133
<i>Kunzea robusta</i>	Kānuka	Threatened – Nationally Vulnerable	1.5	15	667
<i>Leptospermum scoparium</i>	Mānuka, tea tree	Not Threatened	1.5	15	667
<i>Olearia paniculata</i>	Akiraho	Not Threatened	1.5	3	133
<i>Pittosporum eugenioides</i>	Tarātā	Not Threatened	1.5	3	133
<i>Pittosporum tenuifolium</i>	Kōhūhū, black matipo	Not Threatened	1.5	3	133
<i>Plagianthus regius</i>	Lowland ribbonwood, mānatu	Not Threatened	1.5	2	89
<i>Podocarpus totara</i>	Lowland tōtara	Not Threatened	1.5	15	667
<i>Prumnopitys taxifolia</i>	Mataī, black pine	Not Threatened	1.5	15	667
<i>Pseudopanax crassifolius</i>	Lancewood, horoeka	Not Threatened	1.5	2	89
<i>Sophora microphylla</i>	Small-leaved kōwhai	Not Threatened	1.5	3	133
<i>Teucrium parvifolium</i>	NZ verbena, teucrium	At Risk – Declining	1	1	100
<i>Veronica salicifolia</i>	Koromiko	Not Threatened	1	2	200
<b>Total</b>				<b>100</b>	<b>5,108</b>

Table 7: Indigenous plant species to be planted on riparian margins within Management Unit B, Coldstream 2, Rangitata River.

Scientific Name	Common Name	Conservation Status	Spacing (m)	Percentage (%)	Quantity per Hectare
<b>Drier Riparian Margins</b>					
<i>Aristotelia serrata</i>	Wineberry, makomako	Not Threatened	1.5	2	89
<i>Coprosma propinqua</i>	Mingimingi, mikimiki	Not Threatened	1.5	2	89
<i>Coprosma virescens</i>	Mikimiki	Not Threatened	1.5	2	89
<i>Cordyline australis</i>	Cabbage tree, tī kōuka	Not Threatened	1.5	10	445
<i>Coriaria sarmentosa</i>	Tutu	Not Threatened	1	2	200
<i>Dacrycarpus dacrydioides</i>	Kahikatea, white pine	Not Threatened	1	10	1,000
<i>Griselinia littoralis</i>	Broadleaf, kāpuka	Not Threatened	2	2	50
<i>Haloragis erecta</i>	Toatoa	Not Threatened	2	2	50
<i>Leptospermum scoparium</i>	Mānuka, tea tree	Threatened –Nationally Vulnerable	1.5	10	445
<i>Sophora microphylla</i>	Small-leaved kōwhai	Not Threatened	2	2	50
<i>Teuclidium parvifolium</i>	NZ verbena, teuclidium	Not Threatened	1.5	2	89
<i>Veronica salicifolia</i>	Koromiko	Not Threatened	2	2	50
<b>Wetland Riparian Margins</b>					
<i>Austroderia richardii</i>	Toetoe	Not Threatened	1	2	200
<i>Carex buchananii</i>	Cutty grass, matirewa	At Risk – Declining	0.5	2	800
<i>Carex coriacea</i>	Cutty grass, rautahi	Not Threatened	0.5	2	800
<i>Carex geminata</i>	Cutty grass, rautahi	Not Threatened	0.5	2	800
<i>Carex maorica</i>	Cutty grass, rautahi	Not Threatened	0.5	2	800
<i>Carex secta</i>	Pūrei, pūkio	Not Threatened	1	15	1,500
<i>Carex strictissima</i>	Hook grass	Threatened –Nationally Endangered	0.5	2	800
<i>Carex virgata</i>	Swamp sedge	Not Threatened	0.5	2	800
<i>Eleocharis acuta</i>	Sharp spike sedge	Not Threatened	0.5	2	800
<i>Juncus edgariae</i>	Leafless rush, wī	Not Threatened	0.5	2	800
<i>Juncus pallidus</i>	Giant rush, leafless rush, wī	Not Threatened	0.5	2	800
<i>Juncus sarophorus</i>	Leafless rush, wī	Not Threatened	2	2	50
<i>Phormium tenax</i>	Lowland flax, harakeke	Not Threatened	1	15	1,500
<b>Total</b>				<b>100</b>	<b>13,096</b>

## **PLANT SPACINGS**

- Plant trees at 1-3 metre spacings (depending on species).
- Plant shrubs one to two metre spacings (depending on species).
- Sedges, rushes and grasses should generally be planted at 0.5 metre spacings with the exception of species such as pūrei (*Carex secta*) and toetoe (*Austroderia richardii*) which should be planted at one metre spacings.
- Plants should be set back from stock fences by 1.5 metres to prevent livestock browse.

## **SITE PREPARATION PRIOR TO PLANTING**

- Planting areas should be prepared in mid to late autumn, ideally four to six weeks prior to planting. Individual planting sites should have vegetation cover reduced by spraying 0.4 metre round areas with 10% glyphosate in water.
- Herbicide should be applied by a qualified applicator (Growsafe and Approved Handler certified).
- It is important that existing naturally-occurring indigenous vegetation (especially containing Nationally Threatened/At Risk or locally uncommon species) is not adversely affected by the planting programme. Plantings should be integrated with and enhance existing indigenous vegetation as much as possible, therefore no indigenous vegetation should be removed to facilitate planting.

## **TIMING OF PLANTING**

- The timing of planting will be dictated by the rainfall patterns in the intended planting season; however, in general, should be planted from late autumn, once soil moisture levels reach field capacity, through to mid-winter.
- Due to the high levels of shingle at the site, augers may need to be used to prepare holes for planting.

## **PLANT GUARDS**

- Newly-planted trees and shrubs can be decimated by rabbit and hare browse, so protection against browse is critical for plantings that are not protected by rabbit proof fences.
- Individual plant guards should be used to protect each plant if browsing is an issue. They also provide shelter, increased humidity, reduction of moisture loss, and help to prevent unintended herbicide damage.
- Guards should be removed and reused once the foliage of the plants grows out of the top of the guard.

## **MAINTENANCE OF PLANTS**

- In the first 12 months following planting operations, assess plant condition and weed competition every three months.
- For the first two years following planting, plants should be released from environmental weeds a minimum of three times a year by hand weeding or spraying with selective herbicides.
- For up to five years following the planting, further releases from environmental weeds may be required once or twice a year during the growing season by hand weeding or spraying with selective herbicides. When plants are emergent above the surrounding vegetation (typically a grass sward), little further management is required. However, ongoing control of pest plants will be required, particularly before canopy closure is achieved.
- Infill planting to replace plants that have died may be required and should be undertaken during the second or third year after the original planting.



## SUMMARY OF MANAGEMENT ACTIONS AND PRIORITIES FOR COLDSTREAM 2 RESTORATION WORK PLAN

### **KEY OBJECTIVES AND ACTIONS FOR MANAGEMENT ZONES IDENTIFIED IN FIGURE 3**

The focus of this site is dryland habitat restoration. Areas closest to the main braid are vulnerable to flooding or erosion as the river naturally changes course. Focus high-investment restoration actions on inland sites, expanding riverward as resourcing allows. A lack of information about the remaining values and desired end-goal of the site are primary constraints. The workplan below should be modified as habitat or site-specific opportunities, or other ecological values, are identified.

1. Potential river braid restoration area: recognise and promote dynamism, potential area for woody weed control to promote bird habitat and braid plain restoration. Preferred action for braidplain restoration is mulching of woody weeds to promote flood reclamation. Appropriate option should be determined by the available budget and resource consent requirements. Needs to be balanced by risk of enhancing erosion and flood risk of dryland habitats. LINZ land check required before any works.
2. Buffering vegetation: area for no immediate restoration action except for targeted control of key weed species (i.e. grey willow). Leave margin of existing vegetation to buffer against flood erosion. Longer-term, remove and foster indigenous vegetation establishment. High-flood prone area so minimal investment of high-cost actions desirable.
3. Potential wetland planting area: area of dense willow that indicates a potential wetland. Undertake survey to determine habitat status. If habitat supports, control woody weeds and plant wetland species including those of significance to Te Rūnanga o Arowhenua, ongoing pest plant control.
4. Dryland forest planting area: reintroduce dryland forest species, exclude livestock and ideally rabbits and hares, control woody weeds and plant, sprinklers or supplementary watering may be required while plants establish.
5. Proposed dryland forest/treeland planting area: reintroduce dryland forest and shrub species, maintain open mossfields. Exclude livestock and ideally rabbits and hares from planting areas – either entire area or selected planting sites to create pockets of indigenous vegetation, appropriate areas and scale of fencing should be determined after a detailed site survey and consideration of effect on mosslands, control woody weeds and plant in areas of existing gorse shrublands, sprinklers or supplementary watering may be required while plants establish. eradicate woody weeds and control on ongoing basis in intact areas of dryland mossfield. Refer to section 8.7 of report for further details.

6. Progressive woody weed control and dryland planting area. maintain grazing in the medium term, control gorse and exotic shrubs from mosslands, expand planting areas as opportunities and budget allows.
7. Mossfield/stonefield: example of mossland, need to determine if remnant habitat or developed as a result of changing land use, management actions may change depending on status, avoid planting, prevent weed encroachment.
8. Gorse shrubland: example of area suitable for dryland forest planting. Localised mulch/control woody weeds and plant.
9. Exotic grassland: continue livestock grazing, control pest plants as needed, Mature kōwhai a potential seed source for restoration plantings.
10. Erosion risk management area: outside scope of restoration plan, actions to minimise erosion risk to Coldstream 2 site to be considered.
11. Studholme drain/creek: outside scope of restoration plan, historic route of creek to culturally significant Pākiarau kūtū. Consider actions for reinstatement depending of aspirations of Te Rūnanga o Arowhenua, landowners and practicalities versus values. May require a scoping study.
12. Whole area: protect landforms (i.e. prevent plowing), predator control, survey for unknown habitats and values, control wilding pines and other pest plants identified as conservation priorities (i.e. grey willow, stonecrop), create additional lizard habitat, develop fire management plan, renegotiate grazing lease, work with Te Rūnanga o Arowhenua to identify and implement other actions to enhance the ecological integrity, mauri and provision of mahinga kai, implement other actions as identified in the Main Stem restoration plan

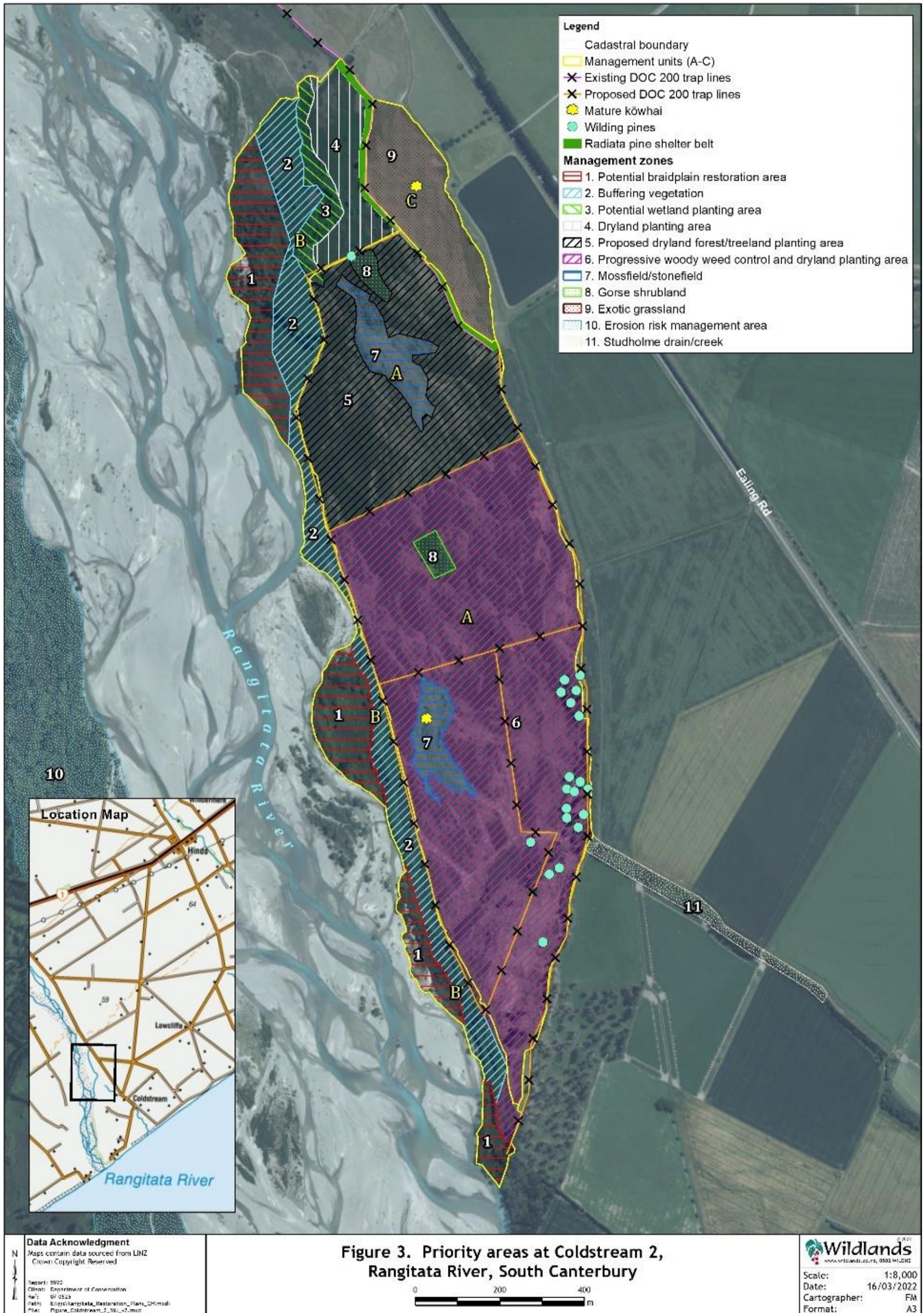
Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Botanical survey	Whole site	To identify remaining botanical values and priority areas and values for restoration	ASAP	Lack of knowledge about remanent values of site constrains development of appropriate restoration plan.
Freshwater fauna and habitat survey	Whole site	Identify to identify and prioritise restoration areas	ASAP	Identify/confirm priority areas.
Invertebrate survey	Whole site	Survey for terrestrial invertebrate values	ASAP	Braided river dryland habitats support species of conservation significance.
Species specific management plans	Priority sites or species identified in species.	Develop species-specific management plans if populations of Threatened or At Risk species are located.	After surveys	Target Threatened, At Risk or Locally Uncommon species. To be guided by Department of Conservation translocation protocols and the tikanga of Te Rūnanga o Arowhenua.
Undertake pest plant survey at the site	Whole site	This survey will identify all pest plants present and control priorities needed	ASAP	Develop pest plant management plan
Develop pest plant management plan	Priority sites identified in surveys	Identify all problematic pest plants and priority areas and species for control	After pest plant survey	<p>Pest plants have the potential to modify the functionality of the braided river system and associated habitats, impacting mahinga kai resources, reducing nesting habitat for indigenous birds and inhibit the regeneration of indigenous vegetation.</p> <p>Grey willow and wilding pine are priorities in dryland habitats on an ongoing basis.</p> <p>Assess the threat of stonecrop to mossland/stonefield values.</p>
Fire management	Whole site	Develop fire management plan	After surveys	Key will be balancing the role fire may play in maintaining dryland mossfield/stonefields against the risk to longer term ecological restoration goals.
Refine restoration plan after survey	Whole site	Define restoration areas, priorities, plant numbers, and appropriate species list	After habitat survey	<p>Better defining areas will allow for more accurate plant number calculations – need for ordering eco-sourced plants</p> <p>Plan may need to be adjusted depending on values, threats and new priorities identified during surveys.</p>
Redefine lease terms	Priority sites identified in surveys	Redefine lease terms and area with current leaseholder.	After refining restoration plan	Restoration actions may not be compatible with existing lease terms and require renegotiation of terms and area.
Order eco-sourced plants and planting materials	Wetland area / Zone 3 Dryland forest / Zones 4 & 5	Order eco-sourced plants and planting materials (plant guards etc.) Refer to Appendix 6 table 4 & 5 for suitable planting species.	ASAP after refining restoration plan	Eco-sourcing is important for the local ecological integrity. Eco-sourcing plants can be a long process. Plants need to be ordered as soon as possible. Not all species will need to be guarded.

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Establish photopoints and monitor	Whole site	Establish photopoints where ecological restoration will occur	Prior to restoration	Good monitoring tool to observe progress and help with future restoration projects.  Drone surveys and other monitoring tools could also be applied.  Undertake regular monitoring as outlined in Section 10.
Mahinga kai feasibility study	Whole site	Undertake an initial feasibility study for the reintroduction of a mahinga kai species (or multiple species).	ASAP - ongoing	Identify opportunities for mahinga kai reintroduction or enhancement with Te Rūnanga o Arowhenua.  Develop and implement a management plan for mahinga kai.
Assess status of mossfield/stonefield	Mossfield/stonefields / Zones 4, 5, & 6	Determine if mossfields relict or not, assess options to elevate protection status	After surveys - ongoing	Mossfields are a significant habitat of the site. Their status may alter management actions.
Grazing trials	Mossfield/stonefields / Zones 4, 5, & 6	Implement trials to determine effect of grazing on mosslands	After surveys - ongoing	Grazing may be maintaining mossfields. The site is suitable for trials to determine best-practise dryland restoration methods.
Pest animal control	Whole site	Establish and install DOC 200 pest animal traps around site perimeter and within areas of dryland habitat to protect ground-nesting indigenous birds, lizards and invertebrates.  Establish supplementary Timms traps for possums.	Autumn/Winter (March-July 2022) On-going - check monthly	Vital to sustain indigenous bird, lizard and some invertebrate species reliant on dryland river habitat. Possums pose threat to restoration plantings.
Pest plant control	Priority sites identified in the surveys.	Target pest plant species (Refer Appendix 5). Spot spray, cut and paste or mulch & digger vegetation removal. Depending on extent of exotic species present and their proximity to waterways.	After pest plant management plan has been developed- June 2022 – ongoing.  Timing depends on target species and method of control.	Pest plants have the potential to modify the functionality of the braided river system, impacting mahinga kai resources, reducing nesting habitat for indigenous birds and inhibit the regeneration of indigenous vegetation.  Priority target areas for gorse control are within planting zones and mosslands. Preventing establishment of gorse in mossland habitats is priority, will require ongoing control.  Assessment of presence of grey willow and threat stonecrop poses to mosslands is required.  Any existing naturally-occurring indigenous vegetation should be identified and flagged (using suitable flagging tape), so as not to be removed, or damaged during pest plant control.  <b>Critical that control occurs on an annual ongoing basis.</b>

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Note: Planting and site preparation efforts have been split to make it more manageable timewise, with a second site preparation and planting phase to be undertaken in either the follow spring or Autumn to ensure maximum plant survival.				
Mark out planting zones	Dryland forest / Zone 4 (and selected areas of Zone 5)  Wetland / Zone 3	Suitable areas for planting within dryland and potential wetland zones to be identified and marked out	Autumn / Winter 2022	Scale of planting to be determined by budget and ecological restoration goals.  Planting clumps or strips of indigenous vegetation within these zones will provide seed source to promoted natural regeneration into the surrounding zones.  Areas with greatest soil depth and leaf mulch should be selected for planting to ensure maximum survival. Likely to coincide with areas of gorse or damper channels.  Avoid areas at risk of flooding or erosion Existing naturally-occurring indigenous vegetation should be re-identified and flagged (if flagging no longer present) Where possible planting should be integrated with existing indigenous vegetation.
Fence installation	Dryland forest / Zone 4 (and selected areas of Zone 5)  Wetland / Zone 3	Install fencing around planting areas. To encompass entire zone or smaller units depending on planting strategy and cost.	Winter / Spring / Summer 2022	Exclude livestock and ideally rabbits and hares.  The impact of removing grazing from mossfields will need to be considered.
Pest animal control	Dryland forest / Zone 4 (and selected areas of Zone 5)  Wetland / Zone 3	Remove rabbits & hares etc from fenced planting areas.	Prior to planting.	Important for successful establishment of planted species. If rabbit and hare fencing not possible, use suitable plant guards.
Planting site preparation	Dryland forest / Zone 4 (and selected areas of Zone 5)  Wetland / Zone 3	Control pest plants within planting zones. Mulch planting areas or alternatively spot spray planting sites (0.4 metre round areas with 1% glyphosate or other suitable herbicide depending on target species and time of year).	Late summer early autumn. At least one month prior to planting	This is important for successful establishment of planted species and makes it easier and/or more efficient for planting.  Mulching of gorse areas preferred site preparation method.  Supplementary watering may be required in dryland habitats.  <b>All chemical pest plant control should be undertaken by experienced Growsafe certified operators.</b>

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
		Install watering system if needed.		
Planting	Dryland forest / Zone 4 (and selected areas of Zone 5) Wetland / Zone 3	Plant and guard species were necessary. Plant at 1 – 1.5 m spacing for shrub/tree species. Refer: Appendix 5, Table 4, 5, 6 & 7 – for planting list and specifications.	Autumn 2023 At least one month after site preparation	Create a seed source for future natural regeneration, and enhance current habitats.  In dryland areas planting should be undertaken from late autumn through to mid-winter. Once soil moisture levels reach full capacity.
Planting site maintenance	Dryland forest / Zone 4 (and selected areas of Zone 5) Wetland / Zone 3	Spray (Glyphosate) or hand release plants from weeds and pest plants as required.	At least 3-4 visits over Spring-Summer for the first 3 years - after planting. Then ongoing as required until plantings have established	This is vital for the successful establishment of the planting areas. Invading weeds can quickly establish and complete/outgrown planted species.
Mark out planting zones	Additional areas in Zone 5. Planting areas in Zone 6 (if budget allows)	Mark out planting areas	Spring / Summer 2023	Clearly identify the planting zones to prior to site preparation.  Existing naturally-occurring indigenous vegetation should be re-identified and flagged (if flagging no longer present) Where possible planting should be integrated with existing indigenous vegetation.
Planting site preparation	Additional areas in Zone 5. Planting areas in Zone 6 (if budget allows)	Control pest plants within planting zones. Mulch planting areas or alternatively spot spray planting sites (0.4 metre round areas with 1% glyphosate or other suitable herbicide depending on target species and time of year). Install watering system if needed.	Late summer early autumn. At least one month prior to planting	This is important for successful establishment of planted species and makes it easier and/or more efficient for planting.
Planting	Additional areas in Zone 5. Planting areas in Zone 6 (if budget allows)	Plant and guard species were necessary. Plant at 1 – 1.5 m spacing for shrub/tree species.	Autumn 2024 At least one month after site preparation	Create a seed source for future natural regeneration, and enhance current habitats.  In dryland areas planting should be undertaken from late autumn through to mid-winter. Once soil moisture levels reach full capacity.

Activity/Task	Area/Zone (Refer Figure 3)	Activity Required	Timing	Objective/Reason
Planting site maintenance	Additional areas in Zone 5. Planting areas in Zone 6 (if budget allows)	Spray (Glyphosate) or hand release plants from weeds and pest plants as required. Control gorse, broom and other woody pest plant regeneration as required – using suitable herbicide and experienced growsafe certified operators.	At least 3-4 visits over Spring-Summer for the first 3 years - after planting. Then ongoing as required until plantings have established	This is vital for the successful establishment of the planting areas. Invading weeds can quickly establish and complete/outgrown planted species.
Infill planting	All planting areas	Infill planting to replace plants that have died	Second or third year after the original planting.	Required to establish canopy closure.
Undertake feasibility assessment for braid plain restoration on south side of Rangitata	Erosion risk management area / Zone 10	Assess opportunities to undertake woody weed control on adjacent side of the Rangitata river to lesson flood and erosion risk.  Apply for resource consent if required.	Spring / Summer 2022 - ongoing	Increasing braidplain extent on the south bank of the Rangatata could reduce erosion and flood risk to Coldstream 2.
Braidplain restoration (If assessed as feasible)	Potential braidplain restoration / Zone 1	Assess opportunities to undertake woody weed control to create braidplain habitat.  Apply for resource consent if required.	Spring / Summer 2022 - ongoing	Control pest plants in areas where braid plain restoration will take place and undertake works to remove the vegetation.  The appropriate option should be determined by available budget and resource consent requirements but could include burying, mechanically mulch or transport the material off sites.  Carry out a land status check with LINZ prior to braid plain restoration.  Critical to assess potential increase in flood/erosion risk of main site if this action is implemented.
Create additional lizard habitat	Dryland areas / Zones 4, 5 & 6	Create artificial refugia (e.g. piles of stones or logs) within the dryland mossfield/stonefield	Spring / Summer 2022 - ongoing	Significant populations of southern grass skink or other threatened lizards may be located at the site.



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Plate 1: Gorse shrublands and grazed exotic grassland within the degraded dryland mossfield/stonefield at the Coldstream 2 site. 9 July 2021.



Plate 2: Mossfield and low stature grassland within the mossfield/stonefield at the Coldstream 2 site. Scattered gorse and crack willow are present in the background. 9 July 2021.



Plate 3: A large kōwhai at the site. Kōwhai and other dryland indigenous tree and shrub species were likely historically common at the site. 9 July 2021.



Plate 4: A wilding radiata pine growing amongst gorse shrubland. All wilding conifers should be controlled throughout the wider site. 9 July 2021.



Plate 5: Scattered gorse and tree lupin shrubland growing in the braid plain on the northwest margins of the site (looking southeast). 9 July 2021.



Plate 6: Crack willow forest emergent over gorse-Scotch broom-blackberry shrubland within Management Unit B. 9 July 2021.



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