MACKENZIE WILDING CONIFER MANAGEMENT STRATEGY

Environment Canterbury
Your regional council

Department of Conservation
Te Papa Atawhai

Land Information New Zealand
Toitū te whenua

MACKENZIE DISTRICT COUNCIL

A strategic plan developed for the management and control of wilding conifers in the Mackenzie Wilding Conifer Management Zone 2016-2030 for Environment Canterbury, Department of Conservation, Land Information NZ and the Mackenzie District Council

TE MANAHUNA CONSULTING

Te Manahuna Consulting was engaged to undertake the development of this strategy. The director of Te Manahuna Consulting, Rob Young has been engaged in the business of wilding conifer spread and control since the early 1960's when he planted several Douglas fir trees at the family bach at Bealey Spur. Many years later he removed these conifers but an ongoing chore on visits to Bealey Spur is the removal of D. Fir seedlings.

In a professional career in conservation management spanning 34 years Rob was involved with the management of the wilding conifers in the Waitaki catchment. Under his leadership the Department of Conservation started a control programme in the Kirkliston Range in 1991 utilising employment scheme labour. This evolved over the next 22 years into the existing contract based and a much more sophisticated programme to include all the land managed by the Department in this area.

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Others who assisted with the development of this strategy include Dawn Palmer, Keith Briden, Graham Sullivan, Andrew Simpson, Simon Cameron, Susan Walker, Marcus Girvan, John Keenan and Garth Nixon. I would also like to acknowledge Sue Young for her assistance with ongoing proof reading and support with many other tasks that got it across the line. Thanks to Nicola Graham for the final independent proof read.

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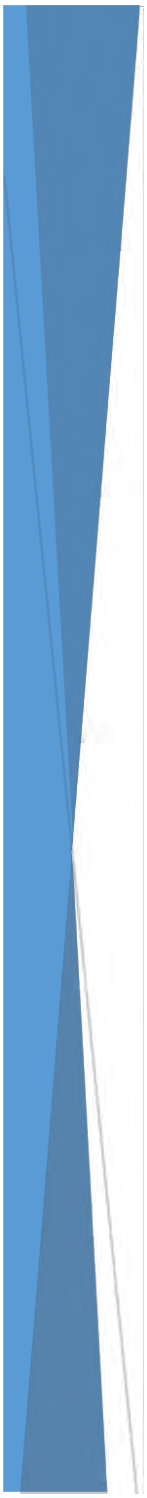
1 Executive Summary

The Mackenzie Basin is an iconic landscape that touches the hearts of many New Zealanders and in particular the people who live amongst its "big skies" and vast landscapes. In recent times wilding conifers have come to dominate parts of these landscapes at an alarming rate. For the local landholders and agency managers, this affinity with New Zealand's largest and least modified intermontane basin, and its importance for their livelihoods has been the catalyst for this strategy.



Time to act
This strategy calls for bold action. It will require coordinated and ongoing action at several levels amongst all stakeholders to ensure the successful implementation on the ground over a timeframe of 10 to 15 years. The time for debate is over. Wilding conifers do not have a place in the South Island high country and the Mackenzie is one part of the South Island where it is still feasible to change the course of this weed invasion.

These "space invaders" transform landscapes and have significant effects on a range of values in these high country places which can negatively affect economic production, natural ecosystems and recreation.

The Mackenzie Wilding Conifer Management Zone (MWCM Zone) covers an area of 535,305 hectares (3.5 per cent of the South Island).

The concept of this collaborative non statutory strategy had the support of 98 per cent of the landholders and agencies consulted during its development. Awareness of the national strategy "The Right Tree in the Right Place" which has provided the standards and background for this strategy was also very high amongst landholders.

Over the years the seriousness of the wilding conifer invasion in the South Island High Country has been described in many reports. The recent MPI report "The Right Tree in the Right Place" outlines the alarming rate at which these pest weeds are invading New Zealand's land mass – another 90,000 hectares per year or 5 per cent per annum. In the last 20 years the Mackenzie has become a prime example of this rapid invasion by these "space invaders" with nearly 130,000 hectares (or 24 per cent) of the MWCM Zone now affected.

The implementation of this strategy is split into two stages: 10 year and 15 year goals and aims for zero density Pinus contorta in most of this area inside 10 years. There are 5 major seed sources which are the core of the problem and two of these will require separate

operational plans to achieve complete zero density contorta and management of the other spreading species by 2030.

Currently wilding conifers continue to spread and expand across the Mackenzie despite the fact that a combined total of $2.2M is spent annually on their management and control by both private and public land managers. The cold hard truth of this is that this level of expenditure is insufficient to reverse this expansion and this strategy estimates that the initial removal across this 130,000 hectares requires an additional $28M to be spent over a 15 year period. This is effectively doubling the current expenditure level per annum. Follow-up control after initial removal of the spread over the 130,000 ha has been estimated at between $1m to $3.25m per annum.

The five keys to success of this strategy are:

- the initial removal of all isolated contorta seed sources;
- removal of all sparse and scattered outlier spread;
- ensuring an adequate up-front investment;
- achieving zero density contorta across the zone;
- finding economic ways to remove the two largest seed sources.

The goal for the whole MWCM Zone is the "Two Thumbs scenario" where surveillance by helicopter across an area of 30,000 hectares, every 3-4 years locates around 200 pre coning wilding conifers at a cost of less than $1.00 per ha. This "Mackenzie Wilding Conifer Management Strategy" is the road map to that goal.

Photo 1: The Mackenzie Basin - the largest and least modified intermontane basin in NZ: Photo: R. Young.

2 Background

2.1 Introduction

This strategy has been prepared as a basis for coordinating the removal and management of wilding conifers in the "Mackenzie Basin". Currently there is significant effort and funding being used to manage the wilding conifer issue in the Mackenzie Basin with a level of coordination between some agencies and landholders. The four organisations which organised and funded this strategy; Environment Canterbury, Department of Conservation, Land Information NZ and the Mackenzie District Council will utilise this strategy to assist in achieving greater coordination, collaboration, funding efficiencies and as a lever to increase the funding for the removal of wilding conifer spread.

2.2 Scope and purpose of this strategy

The strategy covers the "Mackenzie Basin" as loosely defined by all of the catchments which flow into the Ohau, Pukaki and Tekapo Rivers and then into Lake Benmore. The area is defined on Map 2: Map of Mackenzie Wilding Conifer Management Zone (p.5). The area which is covered by the strategy (535,305 ha) has been called the Mackenzie Wilding Conifer Management Zone (MWCM Zone).

The overriding goal of this strategy is to remove, contain and manage the spread of wilding conifers in the Mackenzie Basin across all land tenures within this strategy area. This strategy will rely on a collaborative effort to produce an integrated outcome of wilding conifer control and management across the land area.

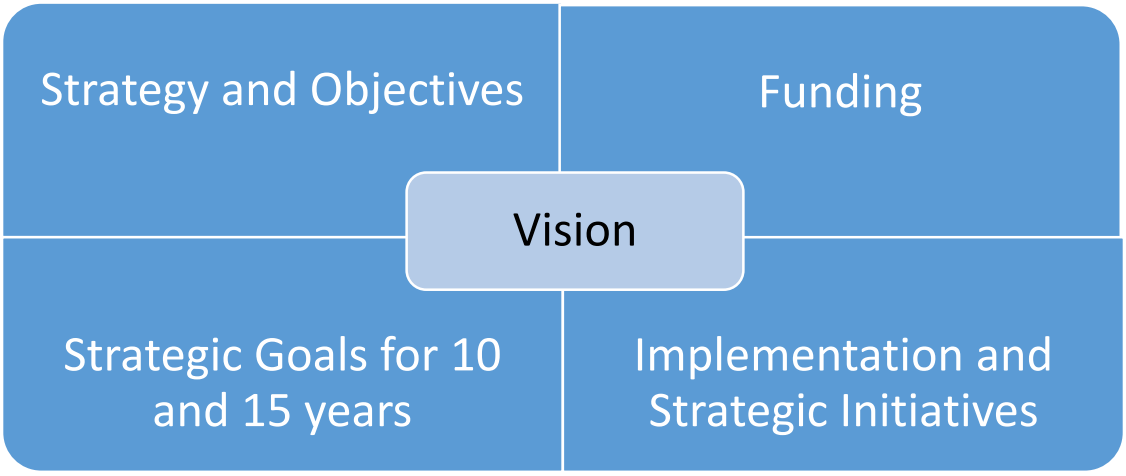
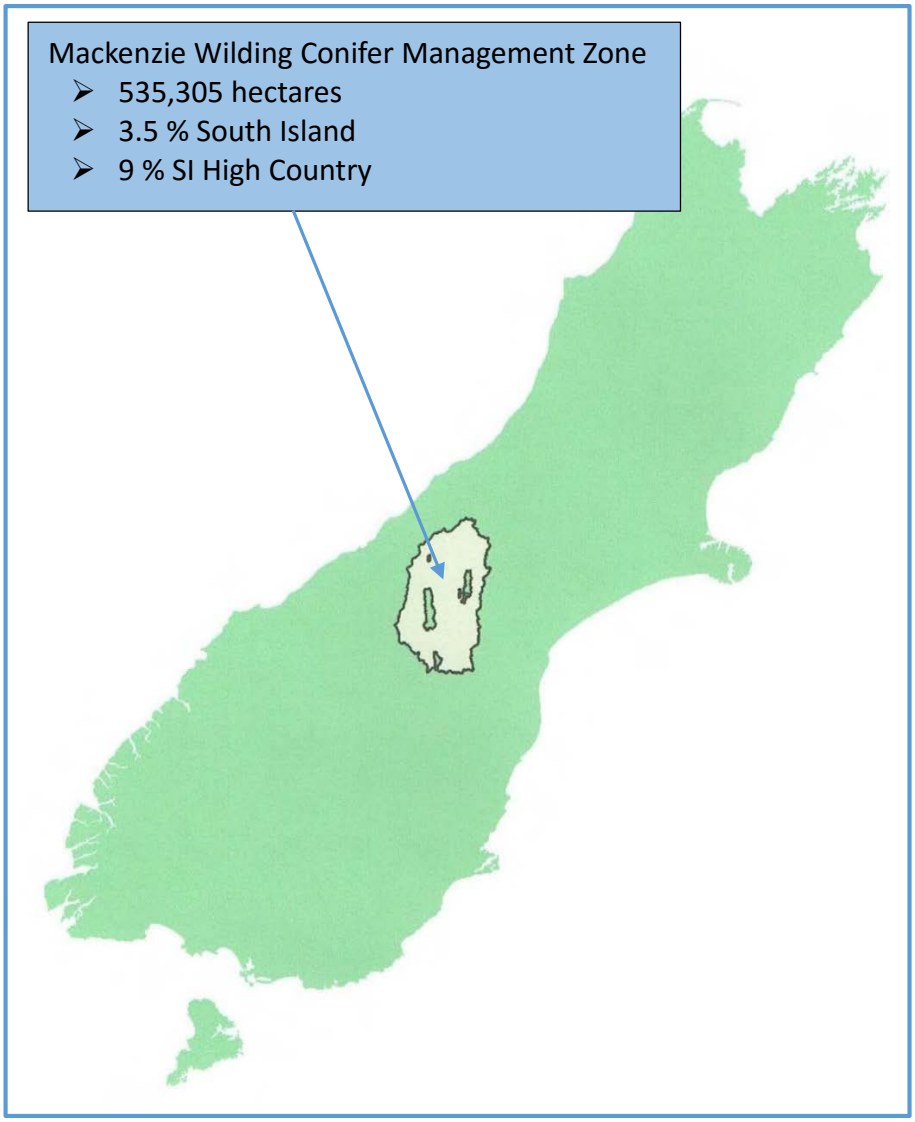


Figure 1: Key Components of the Strategy

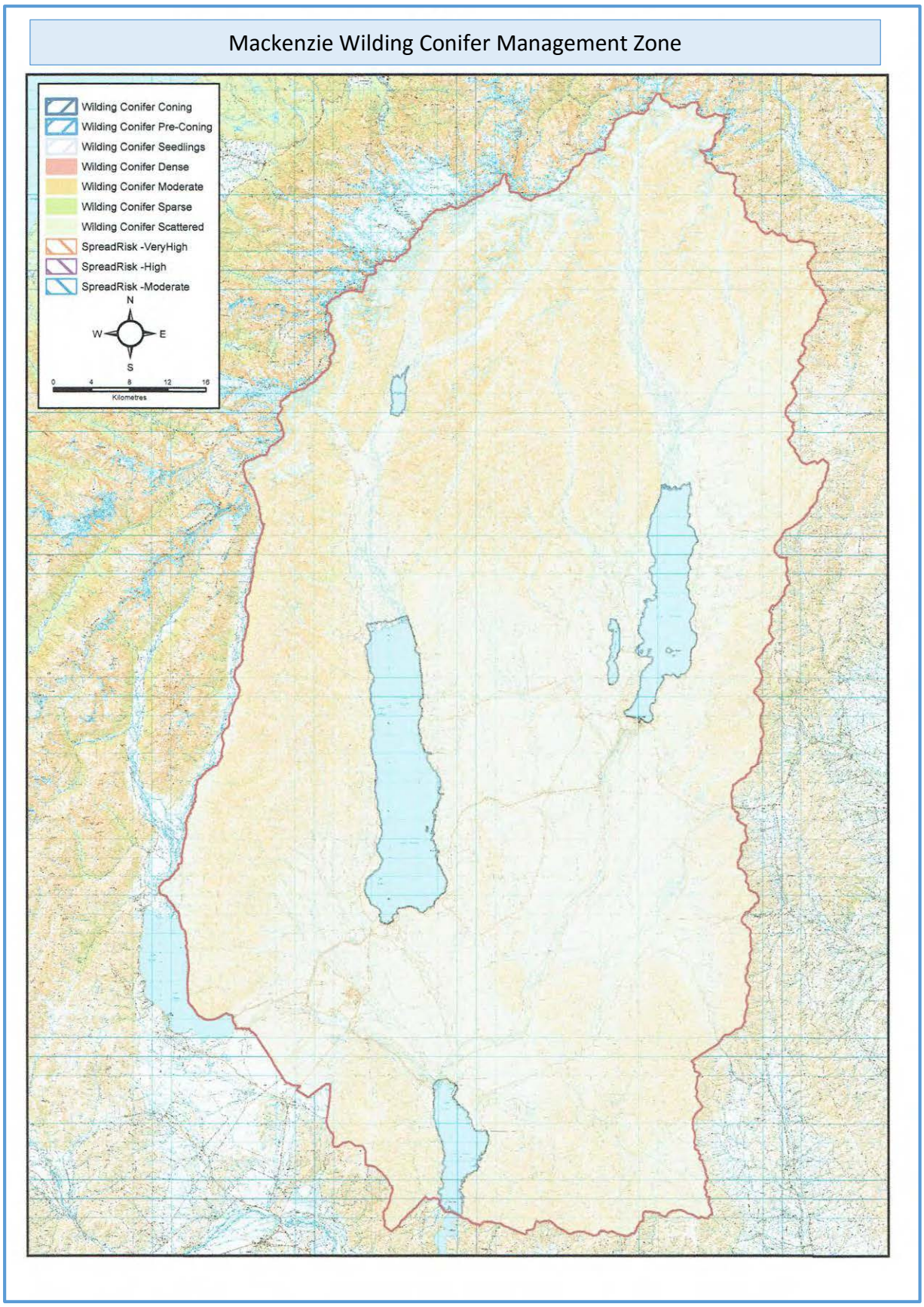
The strategy includes all wilding conifer species. It excludes any other weed tree species as while these pose a significant threat at local levels throughout the MWCM Zone they were not considered a priority for this strategy and are not part of the New Zealand Wilding Conifer Management Strategy (NZWCMS) (MPI, 2014).

This strategy provides a plan that covers all land tenures within this area and should be used for prioritising, integrating and implementing control work across the area over an initial 15 year period by operational managers. The other key purpose of the strategy is to provide a basis for the Mackenzie Wilding Conifer Trust and other organisations to have a sound strategy and rationale for bidding for and leveraging funding from various sources including central and regional government and any trust/lottery funding.

The implementation of this strategy is based on a series of 23 Management Units and 4 Sub Zones which have been used to enable prioritisation between large but similar affected areas of land against each other.



Map 1: South Island and location of MWCM Zone



Map 2: Map of Mackenzie Wilding Conifer Management Zone

2.3 Context - national and regional strategies and policies

This strategy has been prepared utilising the New Zealand Wilding Conifer Management Strategy (MPI, 2014). This strategy was produced in 2014 and contains strategic objectives to ensure clarity of roles of landholders and managers, fair and efficient funding, prioritisation of control and coordination and collaboration across organisations and landholders when implementing control.

This MWCM Strategy is a non-statutory strategy and it supports collaborative action between all the affected parties involved in wilding conifer management. It needs to be implemented under the umbrella and alongside other statutory and non-statutory plans, policies strategies and guidelines[1].

Conceptually this strategy sits under an umbrella of these other documents alongside the relevant legislation as illustrated in Figure 2.

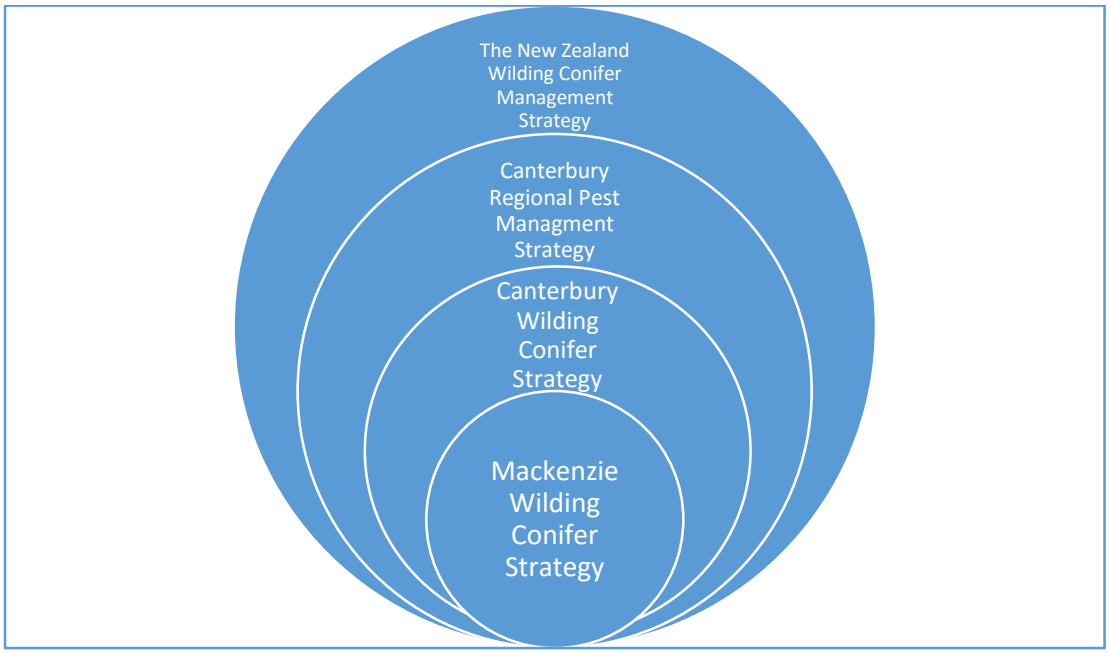


Figure 2: Wilding Conifer Management Strategy levels

2.4 Status of this strategy

This strategy is a non-statutory document[2]. It has no legal status but it is highly likely that in implementing the objectives of this strategy the agencies will advocate for legally binding rules under the Resource Management Act 1991 (RMA) and Biosecurity Act 1993. Such rules will be legally enforceable and are likely to cover the management and control of specific species of wilding conifers to assist in achieving some of the goals of this strategy through statutory processes.

[1] See: - (Waimate District Council, 2014) (Waitaki District Council, 2010) (Mackenzie District Council, 2015) (Canterbury Regional Council, 2011) (MPI, 2014) (Environment Canterbury et al., 2010)

[2] Non statutory document means it has no legal standing in law

3 The Vision

THE VISION

"The Mackenzie Basin landscape without wilding conifers."

THE CONTRA VISION

"The Mackenzie Basin landscape covered in ½ million hectares of wilding conifers."

The Vision or the Contra Vision?

These are the two stark choices we are faced with as the Mackenzie problem continues to grow in size despite the current level of effort and expenditure.

This Strategy provides a planning framework for achieving the Vision.

It requires sustained effort and significant additional funding

4 The Strategy

4.1 The problem of wilding spread in the Mackenzie

Wilding conifers are now seeding and spreading across the whole strategy area. The Mackenzie was cited in the Canterbury Wilding Conifer Strategy 2010-2015 as one of the worst affected areas in the Canterbury region (Environment Canterbury et al., 2010).

4.1.1 How did this happen?

While the expansive extent of this spread is a more recent issue the origins of this problem are the result of over a 150 years of land management in the Mackenzie that has included the planting of trees since the times when the early runs were taken up in the 1860s.

The early enthusiasm for planting trees is recorded on the monument at Burkes Pass erected by T.D. Burnett in 1917 *" …..Oh, ye who enter the portals of the Mackenzie to found homes, take the word of a child of the misty gorges, and plant forest trees for your lives. So shall your mountain facings and river flats be preserved to your children's children for evermore."* (Vance, 1980). By 1922, T.D Burnett had planted no fewer than 60,000 trees at Mount Cook Station (Relph, 2010), which is now one of the most significant wilding conifer seed sources in the Mackenzie. Special conditions were attached to some of the pastoral run licences which required the leasee to plant 0.4 ha of trees per annum in order to reduce soil erosion (Gough, 1985). This condition was still active in the 1960s when P. sylvestris and P. contorta were planted in a long windbreak at Rhoboro Station. The Department of Lands and Survey actually provided the trees and employed a person to assist leasees with these plantings (*pers. comms S. Cameron*).

In the early 1940s, concerns about erosion and soil conservation in New Zealand resulted in the formation of the Waitaki Soil Conservation District and subsequently the Waitaki Catchment Commission (WCC) who planted over 300,000 trees in 99 miles of windbreaks and at high altitude sites, like the Ben Ohau, Diadem and Kirkliston Ranges between 1947 and 1970. At one site alone, within the MWCM zone, the Tekapo Reserve (now the Lake Tekapo Regional Park), 222,000 trees were planted by the WCC prior to 1970 (McCaskill, 1973).

The scale of these tree planting efforts pale into insignificance when they are compared to the planting of 2.4 million trees as part of the scenic and recreational enhancements completed as part of the development of the Upper Waitaki hydro scheme in the period 1957 – 1984, particularly around the shorelines of the man-made or raised lakes and in the Tekapo and Pukaki Rivers (Smith P. , 1985). Only a proportion (around 20 per cent or nearly 500,000) of these trees were conifers, but 38 different conifer species were planted including P. contorta, P. sylvestris, P. nigra, P. mugo, Larch and Douglas fir. In addition, as part of this project 250,000 trees were planted around Twizel in shelterbelts and greenways, again including many conifers. The Mackenzie District Council has 7 plantations within the Mackenzie Basin planted between 1950 and 2000. These commercial plantings all contain spreading conifer species including P.contorta, P. nigra, P. ponderosa, D. fir and Larch.

These so called “legacy plantings” are the root cause of the expansive spread we see today. They were supported and in most cases undertaken and financed by previous and current central, regional and local government agencies including Department of Lands and Survey, the Waitaki Catchment Commission, Ministry of Works, NZ Electricity Department, Canterbury Regional Council and the Mackenzie District Council As these plantings have matured the scale of the seed source problem has increased significantly. In 1964 this view from the bottom of Lake Pukaki (Photo 2) illustrates how generally conifer free the landscape was then prior to the plantings undertaken as part of the Upper Waitaki Hydro Project.

More recently Crown policies allowed the inclusion of conifer species like P. contorta (under the illusion that all trees are good trees) within the Emissions Trading Scheme (ETS). This has made the removal of these trees which are now part of these Crown approved ETS carbon forests (with significant financial liabilities on removal) much more complex.

Photo 2: View from south east corner of Lake Pukaki 1964: Photo: B. R. Young

4.1.2 What is affected now?

Wilding conifers are now established on over 129,000 ha (24 per cent) of the MWCM Zone (535,305 ha). The density of wilding conifers varies across this 129,000 ha from dense closed canopy to scattered outliers. Areas like the Two Thumbs Range have very low levels of spread (scattered outlier spread) where periodic surveillance by helicopter usually finds around 200 pre coning trees over an area of 30,000ha (refer to Photo 5 p. 11).

Other areas within the MWCM Zone have zero density due to their grazing regime (deer), intensive management under irrigation or as crop or feed paddocks. It is estimated that these areas total approximately 25,000-26,000 ha (5 per cent) of the MWCM Zone.

The recent expansive increase in wilding conifers in the Mackenzie is due to a number of factors but does coincide with the reduction in rabbit populations as a result of the success

of RHD. In the 1990s, the area described in this strategy as West Pukaki MU and affected by wilding conifers was significantly smaller than it is now. The two comparison photos below illustrate the rapid increase of wildings at this site as a result of changes in grazing pressure and land management in the last 20 years.

Photo 3: Wilding conifer spread Little Rhoboro Hills and terrace 1998: Photo: R. McNamara

Photo 4: Wilding conifer spread on Little Rhoboro Hills and terrace 2016: Photo: R. Young

This spread originated from the P. contorta planted both on the south eastern part of Pukaki Downs and the Crown plantings undertaken around Lake Pukaki as part of the hydro scheme (Ledgard N. , 2010). The fact that a significant part of this wilding conifer forest is now part of an ETS forest has exacerbated the complexities of its removal.

Photo 5: The Two Thumbs Range, the desired state for the MWCM Zone: Photo: R. Young

4.1.3 Values at risk

The invasion of the Mackenzie area by wilding conifers threatens numerous values and productive uses. It is these potential losses which are the drivers for putting in place an effective and well-funded strategy to contain and minimise the threat of this wilding conifer invasion which has the potential to cover vast areas of the iconic Mackenzie.

These effects include the loss of biodiversity and conservation values, obscuring scenic and landscape values, decreasing the profitability of productive farmland and commercial forests, reducing water yields, affecting recreational and tourism opportunities, increasing the risk of forest fires and impacting on infrastructure like roads and line networks.

Further detail on the values at risk can be found in section 5.2.

4.2 Funding

4.2.1 What is the current level of effort and funding?

Currently wilding conifers continue to spread and expand across the Mackenzie despite the fact that a combined total of $2.2M (averaged over 5 years) is spent annually on their management and control by both private and public land managers.

This $2.2M is made up of an average of private landholder expenditure of $1.36M per annum and a public agency expenditure of $870,000 per annum over the last five years.

In reality, this expenditure is only achieving the maintenance of the status quo situation in terms of spread as most of it is spent on secondary surveillance and control on both public and private land. Of concern is the decline in spend by the Department of Conservation in the last five years on wilding control (due to budget cuts) despite being the manager of 40 per cent (216,000 ha) of the land in the strategy area and having an increasing portfolio of conifer spread prone land due to tenure review.

4.2.2 What level of expenditure is required to be successful and fulfil the vision?

This current level of expenditure is insufficient to reverse the expansion of the wilding conifer spread across the MWCM Zone. On the basis that the existing funding level is not even maintaining the status quo, this strategy estimates that an additional $28M is required to remove all the existing spread (as mapped in 2016) across the current affected area of 129,000 hectares. The figure of $28M is based on current cost and area, and does not take

into account the increased cost over time or the increasing area and density of the wilding conifers. The total sum required depends on the timeframe of the control plan and the how much is invested at the front end of the operation. The models depicted in Figure 3 show the differing timescales of each additional investment rate. With an annual expenditure of between $4-5M the strategic objectives of this plan will be achieved in 8-12 years, but the total additional investment required to do this is $40-$50M. Frontloading the investment at a rate greater than an additional $4-5M per year will reduce the cost and control period further. The cost of follow-up control will be in addition to this total sum.

The current level of expenditure will never achieve the vision and in fact the current level of expenditure given the significant expansion of the spread in the last 10-15 years is probably not going to even maintain the status quo situation. While there will be gains in some areas there will be losses in others. The conifer spread problem in the Mackenzie has now reached a size where the existing funding is not sufficient to make positive traction. The idea that something significantly different can be achieved (a step change) with the existing funding levels by being more efficient and better coordinated is unrealistic. Basically, to achieve a significantly different outcome the funding for the strategy area needs to be doubled or tripled on a per annum basis.

4.2.3 What if we delay providing additional funding?

Any further delays in providing additional funding for this problem will very rapidly turn the current $28M funding issue into a significantly larger one (see **Error! Reference source not found.**). At a 10 per cent increase rate within 9 years the cost has doubled and grows to nearly $450M within 30 years. At a 15 per cent increase rate the cost doubles within 6 years and reaches $1.6B within 30 years. However, by spending an additional $2.55M per annum the cost can be maintained at $28M and any expenditure above this level will start to make some traction.

4.2.4 Where should the additional funding come from?

Vital to the answer to this question of who should pay is deciding who are the exacerbators and beneficiaries. Figure 3 demonstrates the additional funding required to succeed with the vision and strategy, inside the 15 year timeline, is in the order of $3-4M per annum.

The publication by the Crown of the national strategy (MPI, 2014) and the growing recognition at central government level of the size and growing cost of the problem are encouraging signs that the Crown will potentially be an important partner in both this strategy and providing future additional funding.

As illustrated by other trusts involved in wilding conifer work, community and lottery funding can also provide funding for these projects. The recently established Mackenzie Wilding Conifer Trust[3] will be a key partner in gaining this sort of funding.

[3] This trust has not been officially named at the time of publication but has been cited by this this name throughout this report.

4.2.4.1 The exacerbators

Today's problem can be clearly linked to the historic plantings of conifers for catchment protection, windbreak, amenity and forest purposes over the past 150 years. Significantly the major portion of these plantings were undertaken by previous central and regional government agencies under the legislation and accepted best practice at the time. As outlined these central and regional levels of government are largely responsible for both direct and indirect involvement in these legacy plantings and therefore need to be making a significant contribution to this funding shortfall.

While these agencies are clearly exacerbators they are also beneficiaries of any future control as the lands managed by these agencies now are either being invaded or will be invaded in time.

Other exacerbators include those current landholders where seed sources are spreading to adjacent lands. In many cases these are private and pastoral lease landholders where the original seed source for these established seeding conifers was the legacy plantings. Again these landholders and others will also be beneficiaries of any control programme.

4.2.4.2 The beneficiaries

Aside from all levels of government and the landholders, the beneficiaries of this wilding conifer management are varied and represent many sectors of the community. They include the tourism sector, hydro generation companies, forest owners, recreationalists, irrigators, highway managers, line network companies and the rural fire service. The Crown is also a significant beneficiary by way of taxation from both GST and other taxes on the profitable activities of these other beneficiaries.

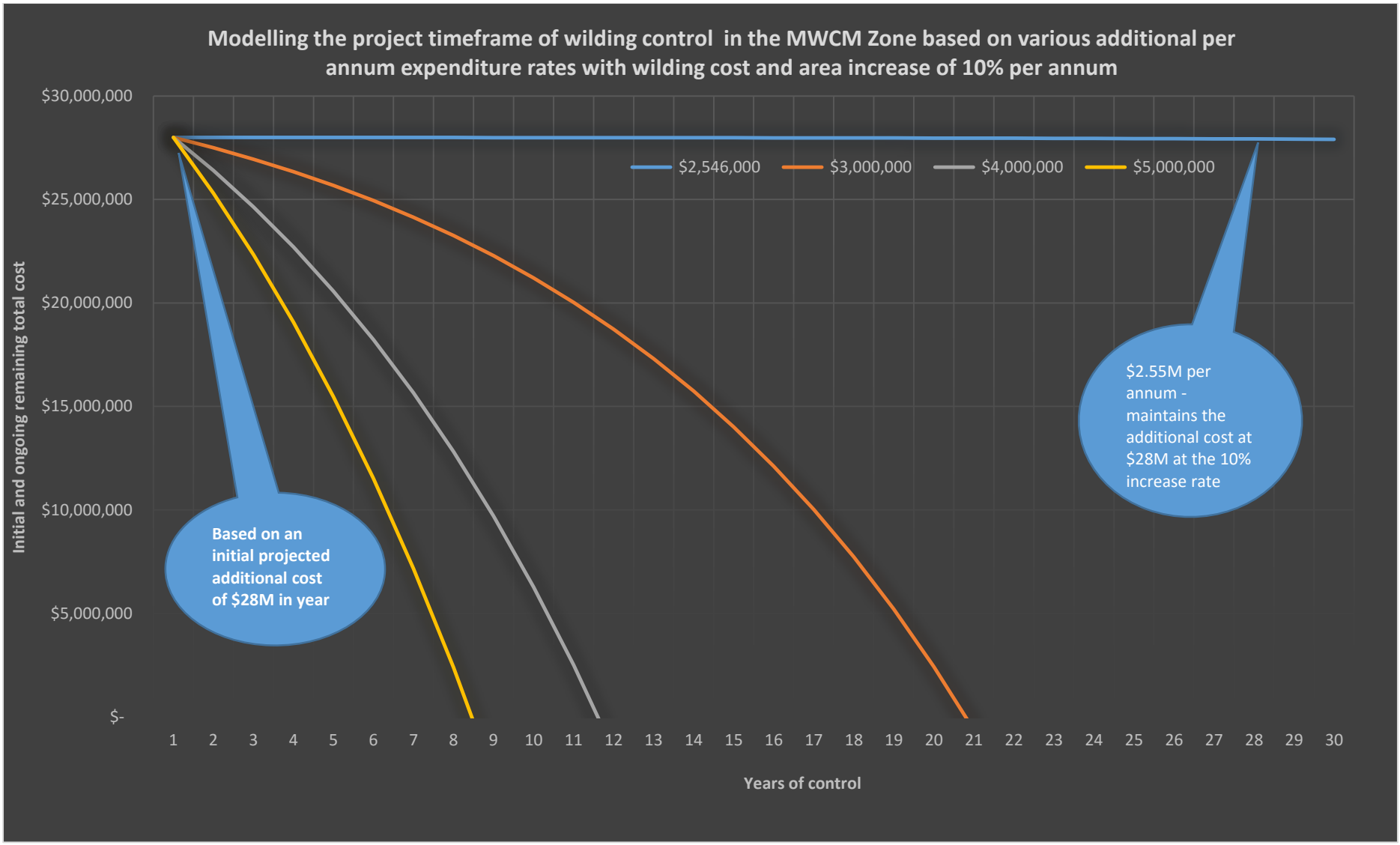


Figure 3: Model of projected cost of completing initial wilding conifer control across the MWCM Zone

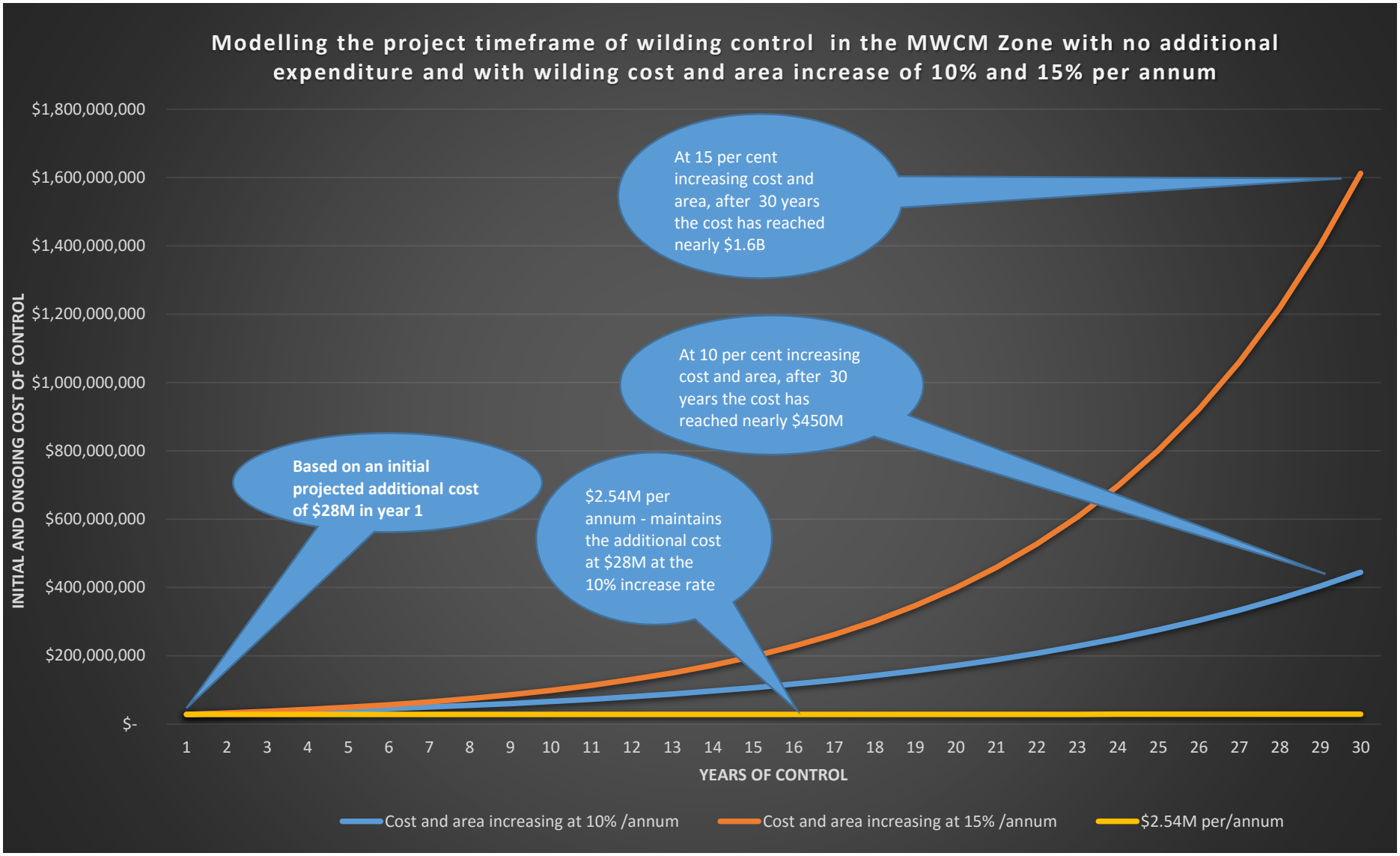


Figure 4: Model of the cost increase with no additional expenditure

4.3 Strategic objectives:

There are ten strategic objectives which are the core objectives of this strategy. These are further developed with strategic implementation actions in the strategic planning and implementation section of this document (see Implementation of the Strategic objectives p. 38).

4.3.1 Strategic Objective 1: Clarify roles and responsibilities and establish a coordinated regime to maximise cost efficiencies

Determine and confirm the roles and responsibilities of the agencies, landholders and other organisations and coordinate the work between the agencies and landholders to maximise cost efficiencies.

4.3.2 Strategic Objective 2: Funding

Secure the funding to undertake the implementation of this strategy and allocate the costs and expenditure in accordance with best practice and the key principles of wilding conifer control.

4.3.3 Strategic Objective 3: Implementing the control programme

Implement the programme utilising best practice, annual planning and professional and experienced contractors.

4.3.4 Strategic Objective 4: Distribution of wilding conifers

Determine the complete distribution of all wilding conifers and undertake ongoing monitoring of the distribution within the MWCM Zone.

4.3.5 Strategic Objective 5: Prioritise the management of wilding conifers

Prioritise the wilding conifer control work by preventing, containing and removing spread with both species led and site led strategies.

4.3.6 Strategic objective 6: Post control management

Maintain effective post control and secondary management to ensure that conifers do not re-establish in areas where initial control has been completed.

4.3.7 Strategic objective 7: Awareness, education and social change

Undertake awareness, education and social change to ensure the strategy is supported and successful.

4.3.8 Strategic objective 8: Regulatory options

Advocate and collaborate to achieve regulatory controls for wilding conifer management and forestry in the MWCM Zone.

4.3.9 Strategic objective 9: Research

Promote the Mackenzie as a region for ongoing national research and support local research into wilding conifer management in a coordinated manner.

4.3.10 Strategic Objective 10: Alternative options for control and secondary follow-up

Explore options for major seed source control in West Pukaki and Mount Cook Management Units.

5 Current status and management of wilding conifers

5.1 Methodology for preparing the strategy

The strategy included updating the mapping of wilding conifer spread (last done in 2013), and planning and costing the control of wilding conifer spread across the study area. In order for this strategy to be successful and become a tool for both managing the control of wilding conifers and seeking funding it requires support and involvement from affected landholders.

The proposed strategy and current and future wilding conifer management was discussed at individual meetings with landholders and managers. These meetings were utilised to gain an understanding of individual wilding conifer issues, collect any relevant data and information (including desktop mapping of each property). Prior to each meeting landholders were emailed with a brief of the process and forwarded a copy of the national strategy.

The data was amalgamated into a table and the summary information was used to inform this report and the development of appropriate strategic objectives. This table is available as Appendix 4: Summary of responses from landholder interviews (p. 101).

The mapping information gathered as part of this work was uploaded into a GIS mapping platform at the Department of Conservation (DOC) in Christchurch, this was also utilised in the development of appropriate strategic objectives. The mapping has been undertaken in ARCMAP and has been published as a project which can be read with ARCREADER. Map copies are available on DVD.

The strategy is based on a series of 23 Management Units and 4 Sub Zones which have been used to enable prioritisation between large but similar affected areas of land against each other. It is proposed to have both species led and site led control strategies.

Discussions were held with numerous land managers and people with expertise in the field of wilding conifer management during the development of this strategy to enable the evolution of ideas and feedback.

5.2 Potential effects of large scale wilding conifer invasion

5.2.1 Biodiversity values

The Mackenzie Basin supports the highest density and area of naturally rare ecosystems of any region in New Zealand of a similar size. The remaining native ecosystems, all on low lying glacial landforms are almost entirely comprised of six naturally rare ecosystems including dryland moraines, ephemeral wetlands, inland sand dunes and gravel outwashes. Most of these ecosystems are Critically Endangered and internationally distinctive. These ecosystems are not found elsewhere in New Zealand and they support at least 6 per cent (68 species) of New Zealand's nationally threatened and at risk plant species, threatened endemic birds (like

kaki/black stilt and wrybill), reptiles, invertebrates and freshwater fishes. Many of these species are endemic to the Mackenzie (*pers. comms. Susan Walker*).

Loss of these ecosystems and whole habitats, extinction of species and transformation to a dense canopy of wilding conifers is the long term potential outcome from uncontrolled wilding conifer invasion. The paper "Wilding conifer control: how important is it relative to other conservation actions?" (Stephens, 2003) noted that the importance of wilding conifer control relative to other conservation actions varies with ecological context. The report notes that "In eastern dry land environments such as occur in the Twizel Area, wilding conifers have both substantial opportunities to spread and the potential to change the natural composition, structure, and function of native communities and to alter the course of natural succession from grasslands back to woody shrubland vegetation at the landscape scale." As a result, wilding conifer control was ranked as the most important conservation programme within the Twizel area.

5.2.2 Loss of productive farmland

In the expansive dry grasslands of the eastern South Island wilding conifer spread tends to mostly affect the "unimproved" grasslands which are managed using low levels of stocking. On the intensively farmed areas of the high country runs wilding conifer invasion is usually not a problem. On other lands particularly where there is heavy seed rain from neighbouring large seed sources the control of wilding conifers is often hard to justify on an economic basis given the marginal value of the land for grazing. This leads some landowners and occupiers to leave the wilding conifers, which then spread further affecting other adjacent farmland and public lands.

5.2.3 Production forest

In some situations wilding conifer spread can affect production forests. The Ben Ohau Forest which is planted in D. fir is subject to P. contorta invasion from the West Pukaki MU. The removal of up to 1500 seedlings of P. contorta from this plantation on an annual basis is a cost for the forest owner *(pers.comms. R. Belton).* Allowing progression of these seedlings to coning age would eventually lead to an increasing number of wildings competing with the planted trees and higher harvesting cost.

Establishing a production forest on land invaded by wilding conifers is likely to be more complex as wildings have to be removed before the new forest species can be established. Most wilding forests are not commercially viable because they are the wrong species (e.g., P. contorta), are not good form or are sited in areas that are expensive to access and harvest. There is also the risk of pests, diseases and fire spreading from wilding forests to production forests.

5.2.4 Landscape values

Exotic conifer spread is seen by many people as a threat to the landscape values of the Mackenzie Basin. These naturally treeless landscapes famous for their golden brown hues, wide open spaces and views to the Southern Alps are completely altered once the spread reaches the moderate to dense canopy stages. An example of this is the obstruction of the

viewing corridor and complete loss of the grassland landscape from the Aoraki Mount Cook highway for the first 10km after the turnoff from SH 8.

These landscape values are recognised in both District Plans through zoning and establishment of Lakeside Protection Areas.

5.2.5 Water yields

The establishment of forest species in dryland grasslands has been shown to reduce water yield and reduce surface run off and stream flow. Data from a number of New Zealand catchment studies where pasture has been replaced by radiata pine forest has shown there was a reduction in annual surface water yields of 30-81 per cent. The upper end of the range was observed in the dry South Island sites (Davie & Foley, 2004).

Water has a significant value both economically and culturally. The recent drying up of Lake Wardell (near Twizel) is most likely the result of the invasion of wilding conifers in the Tay Stream catchment affecting its flow according to local landholders. While this has clearly been a recreational and social impact further water yield reductions will have economic impacts. Reduction in water yields clearly reduces the availability of water for productive uses such as irrigation, stock water and hydro power.

The Waitaki produces 30 per cent of New Zealand's electricity. Water yield reductions due to the continued expansion of wilding trees will have a significant impact on the ability of Meridian and Genesis to maintain current capacity. Continued expansion and thickening up of wilding conifer stands if left uncontained will have a significant impact on this industry if the changes are of the order of 30-81 per cent as outlined above.

Reduction in water yields can have significant effects on wetland ecosystems such as causing the loss of plant species and on habitats for both native fish and trout.

5.2.6 Recreation

Recreational opportunities can both be negatively and positively affected by the presence of wilding conifers. In the treeless landscapes of the Mackenzie the shade offered by trees is often a welcome attribute in the middle of summer for active recreationalists. However, the development of a closed canopy wilding conifer forest at the West Pukaki MU clearly demonstrates the potential for this phenomena to dramatically alter the recreation experience. Much of this closed canopy forest is impossible to walk through or access other areas with stems less than 20cm apart. On balance, the continuing spread of wilding conifers will negatively affect the type of recreational experience people have come to expect in the open grasslands of the Mackenzie.

5.2.7 Tourism

Tourism is also similarly a two edged sword. Landscapes are often perceived in different ways by different people. To some, the treeless wide open landscapes are what attracts and brings them to this place. Others contend that they value the more North American look of the conifer forested landscape. This is an issue which is about personal perception but for many New Zealanders the golden hues and wide open landscapes are an iconic part of the New Zealand identity.

The dry eastern South Island grassland landscapes are something that features in much of New Zealand's international tourism promotion and are a significant part of the attraction of the area for all tourists including the unobstructed views to the Southern Alps. These are some of the landscapes made more famous by "The Lord of the Rings" movies and in one local case tours to the "Pellinor Fields" are the central part of local Twizel tourism business. This tourism business relies on maintaining the integrity of the "Pellinor Fields" site without wilding conifers.

Many of the other values affected by wilding conifer spread are also key elements of the tourism experience for both domestic and international tourists. These values include recreational access, fishing, water quality and quantity.

5.2.8 Fire

Wildfires in wilding conifer forests pose a significant risk to both life and property. Conifer wildfires produce significantly more heat and can move very rapidly in the dry eastern South Island. In 2008 a fire which started in the wilding conifer forest at Mount Cook Station reached extreme fire intensities, travelled 3.5km in 12 hours, and fire embers were being carried up to 1.5km in front of the fire front. This fire exhibited extreme fire behaviour at times and threatened properties downwind of it. One of the key factors in getting it under control was the lighter grass fuels after it jumped Landslip Creek.

In the area around the northwest edges of Twizel the Mackenzie District Council and owners have undertaken some significant work on both the planted shelter belts and wilding conifer spread to reduce the risk to people and dwellings in this area. However, in West Pukaki MU where closed canopy P. contorta forest has established and at Manuka Terrace where wildings are at moderate density there is a significant threat to both the dwellings and people in the event of a wildfire. While defensive mechanisms like clearing trees and having green areas around dwellings can be undertaken, the size and volume of the fuel in these forests is huge and these defensive mechanisms will be of little use in the event of a wildfire in the major seed source MU's. The risks associated with fire continue to increase as the wilding spread continues to expand and thickens up and the effects of climate change become more apparent.

5.2.9 Road icing

The N.Z. Transport Authority (NZTA) is concerned about the presence of wilding conifers on the roadside berms and undertakes a control programme along the 160 km of highway system within the MWCM Zone (*pers. comms J. Keenan*). The visibility reduction for drivers and the shading effect of conifers causing icing on the highway are the main concerns. Again the West Pukaki MU poses the greatest risk where shading has started to cause significant road icing problems in the winter season. As a result NZTA has cleared the forest edge to prevent this encroachment shading the road.

5.2.10 Line networks

Wilding conifers are also a management and cost issue for transmission line companies. Wildfires often interrupt the transmission of power and from time to time power companies

have to clear the conifers from under the powerlines. As standing trees and also once cleared they are a fire risk with an obvious ignition source.

5.3 Factors influencing spread

There are several factors determining spread which have been covered in previous reports and strategies (Harding, 2001) (Pringle & Willsman, 2013). The main factors in the MWCM Zone are:

- Wilding conifers establish easily and grow rapidly in both the natural and exotic grasslands of the Mackenzie. Prior to human occupation the ecosystems of the Mackenzie had evolved to a much more woody plant dominated vegetation cover. Wilding conifers now appear to be filling this niche. In much of their original environments herbivores such as elk and deer control the conifer seedlings and regeneration. In some environments natural fires have also been a key part of their evolution. As well, natural pathogens can affect their survival and growth.
- There is a significant difference in the ability of different species of wilding conifer to establish and spread in this environment. Pinus contorta is a much more aggressive species in terms of seedling establishment and spread rate than the other species and can reach coning age much earlier, in some cases within 3-4 years.
- The surrounding land management is a significant factor in determining initial seedling establishment. Natural grasslands, shrublands and mixtures of exotic and natural grasslands are all very prone to wilding conifer invasion. Intensively developed pastures and irrigated paddocks do not favour wilding conifer establishment.
- Grazing pressure both by wild animals such as hares, rabbits, thar and deer and domestic stock will reduce the establishment rates of wilding conifers. Sheep will be effective when mob stocked and the seedlings are small. Deer are very effective at controlling wilding conifers and deer paddocks are generally conifer free (*pers. comms. A. Simpson, M. Burtscher and R. Ivey*).
- Palatability of different species of wildings is another significant factor in their successful establishment and spread. Pinus nigra is much less palatable than other species so it will establish as a seedling even in the presence of grazing. Palatability is also influenced by the surrounding environment, for instance topdressing will increase palatability of seedlings.
- Climate influences the success of wilding conifer establishment including temperature and rainfall. The rainfall gradient across the area is significant with a range from west to east of 4000mm - 300mm per annum which affects both the ability to establish and growth rates. For instance Douglas fir establishes and grows more successfully in the wetter areas with more than 600mm rainfall. Temperature influences both growth rate and cone opening.
- Wind is the most significant of the climatic influences. The NW wind is the prevailing wind and results in the majority of significant spread. Twizel has annual wind runs of 11,000- 15,000 kms and strong gusts of 40 - 100km/hr, the winds can be much stronger in other parts of the area so seed can spread significant distances. At Mid

Dome (Southland) spread of up to 40km from source was recorded (Ledgard N. , 1999). Seed will also spread from other directions, for instance in the prevailing easterly on the eastern side of the Basin and in southerly quarter winds. Conditions for seed germination can often be ideal in these conditions with more moisture than in the drier westerly conditions.

- Presence of mycorrhizal symbionts in the soil where the seedlings establish. This seems to be becoming much more evident in recent years as the conifers establish in new zones.
- Land use change is often cited as the reason for the expansion of wilding conifer spread. The example often used is the changes resulting from tenure review particularly when land becomes public conservation land. While there are examples of this type of invasion happening there are often other factors involved such as the retired land not being clean of wilding conifers in the first place or its proximity to a major seed source on freehold or pastoral lease land.

5.4 Wilding conifers as a resource

Wilding conifers are regarded by some land owners as a resource. They have been utilised as a timber resource by LINZ from the lakeshore plantings of the 1970s and at Mount Cook Station where both planted and wilding conifers have been harvested. However, the opportunities for realising these conifers as a timber resource are limited often by the nature of the site, accessibility and distance to the nearest port. Even more often their value as a timber resource is negated by the poor tree form and lack of silviculture particularly with the most prevalent wilding conifer in the MWCM Zone - Pinus contorta.

Their value as a firewood resource has also been exploited by local people and firewood merchants but on a relatively limited scale as it is also limited to accessible sites. This is potentially something that could be exploited more but will not make a significant impact on the control of these conifers. It could be used as a tool for tidying up highly visual sites after clear-felling operations.

In the past there has been some interest and research into using the resource for bio-fuel but again it is unlikely to be economic given the distance from any bio fuel plant and market. A sustainable supply is also required for biofuel but this could be an option if the spreading conifer species were replanted in a non-spreading tree species.

Plantations in the zone cover over 1350 ha and most commonly include P. nigra, P. ponderosa, Larch and Douglas fir and in some cases P. contorta. The most useful timber comes from both Pinus nigra and Douglas fir. Both of these species make up a significant proportion of the wildings reported by landholders (47% and 32% of the properties respectively). The wilding spread of these high risk spread species is across more than 45,000ha and while they are an important resource their ability to invade vulnerable ground as wildings is a significant issue.

Over the last six years the Emissions Trading Scheme (ETS) has allowed forest owners to use trees for carbon storage and obtain revenue from this source. While the price of carbon

credits has devalued considerably since their initiation some landowners have utilised these credits to pay for wilding conifer control.

Historically the ETS included conifer weed species such as P. contorta but revised rules around the use of carbon credits for wilding forests means this is no longer an option where wilding spread is an issue. In the MWCM Zone parts of the two major wilding conifer seed sources at West Pukaki MU (1251 ha on Pukaki Downs) and at Mount Cook Station (approximately 1700 ha) are registered as ETS carbon forests. Both of these properties entered the ETS before the advent of the current revised rules under which wilding trees are no longer able to be utilised as carbon sinks.

Photo 6: Conifers (P. nigra and ponderosa) harvested for posts in the Mackenzie: Photo R. Young

On Pukaki Downs this has enabled the managers to undertake wilding conifer control utilising this funding.

5.5 Current management

Most landholders report that they have been controlling wilding conifers for at least 10-15 years and in some cases up to 50 years. Some newer landholders have been doing it for lesser periods but this coincides with their purchase of the property and historically previous landowners would have been doing control in most cases.

Virtually all 45 private landholders interviewed are undertaking regular or annual control of wildings on their properties (over a total of 53 properties). The level of this effort ranges in size depending on both the level of threat and the capacity of the landholder to manage it.

Currently private landholders are spending over $880,000 per annum on wilding control (averaged over the last five years). In addition, they are also undertaking nearly 1200 person days per annum of time to control wildings. This equates to 6 full time persons working all year across the region. In total if these hours are costed at $50.00 per hour in the vicinity of $480,000 is incurred as a wage cost and a total of $1,360,000 per annum is currently spent by the private sector on wilding control.

The ability of private landholders to undertake control efforts is usually driven by the economics of the property. While landowners with larger properties often have a more significant problem they are often highly motivated to deal with it given its potential to negatively affect the productive value of the property.

Twenty-four per cent (more than 129,000ha) of the MWCM Zone is affected by wilding conifer spread that requires significant effort to control.

One of the issues that is apparent is that for smaller landholders wilding conifers are often seen as an asset and hence the need to remove them is not a high priority. This is apparent on some of the smaller properties in the West Pukaki MU and the Manuka Terrace MU. While some of the smaller property owners in the West Pukaki MU were interviewed the number of owners in the Manuka Terrace area prevented this group from being interviewed. There are in excess of 150 owners in this area and about 60 of these properties are affected by the moderately dense spread.

In addition to the landholders consulted 6 agency representatives (Mackenzie District Council, N.Z. Defence Force, LINZ (contractor), Department of Conservation, Environment Canterbury and N.Z. Transport Authority) were interviewed utilising the same questionnaire. These agencies are all committed to the proposed strategy and most have been actively committed to programmes of wilding control for some time. Currently between them they have been spending around $700, 000 per annum over the past 5 years.

5.6 Responses land managers and landholders

A total of 57 individual private landholders, agencies and companies were approached as part of the consultation process covering 65 separate properties or agency holdings. Six landholders were not interviewed either because they did not respond to several approaches (email and phone follow-up) or in the end time did not allow further follow-up. The responses of the 45 private land holders and managers (covering 53 properties) who were interviewed were overwhelmingly positive in terms of the development of the strategy and the likelihood of increased funding and increase effort to manage the wilding conifer issue. A copy of the questionnaire is attached at Appendix 2 (p 97). The answers were recorded on a property basis so there were a total of 53 responses analysed.

Key findings include:

- The awareness of the national strategy was high at 91 per cent and 70 per cent of the landholders and managers were supportive of the principles and a further 13 per cent gave their "qualified support[4]" to the principles.
- The combined total of "support" and "qualified support" for a collaborative approach to the Mackenzie problem was 98 per cent.
- Most landholders (96 per cent) had a long term goal focused on controlling or reducing the conifers to zero density.
- Grazing was discussed but many landholders mentioned that standard grazing had minimal impact on the level of regeneration. However, 26 per cent of landholders had used specific grazing methods focused on reducing the problem like mob stocking.
- As noted earlier, around $1.36M has been spent either as cash or in kind time on average over the last 5 years by the private landholders. Even when the two largest contributors are removed from the equation a total of over $800,000 has be spent by the other 51 properties.

These responses show a high level of support for the concept of this strategy and its implementation. This is an extremely positive foundation on which this collaborative strategic approach can be launched. The representatives from six agencies[5] who have a role in land management in the MWCM Zone were all similarly committed to the strategic approach.

5.7 Toolbox and current methods

5.7.1 Current tools

Table 1: outlines the current methods being used in the Mackenzie for wilding conifer control:

[4] "Qualified support" was a positive response but qualified with a condition which related to usually getting more clarity about what it meant for the landholder.

[5] DOC, LINZ, MDC, NZDF, NZTA, ECAN

Table 1: Current methods

Method	Description
Ground control	Trees removed using chainsaws, scrub bars hand tools, lopper and saws. All green needles need to be removed or the stump treated with herbicide.
Skid hopping	Using helicopters to move ground crew members to areas with trees, particularly where they are hard to access
Ground basal bark	Ground technique, the bottom of the tree or the cut stump is treated with herbicide – X-Tree.
Scrub bar	Scrub bar is used in conjunction with chemical application to the stump to prevent any regrowth.
Helicopter Boom Spray	Herbicide is applied via a boom from a helicopter
Helicopter Spot Spraying with wand	Herbicide is applied directly onto the tree using a lance or wand held by an operator in the aircraft.
Machine removal	Diggers, dozers, tractors and mulchers have all been used for removing dense to moderate stands of trees.
Crushing and burning	Crushing with a roller and then burning to dispose of the slash.
Cultivation and discing	Cultivation with large discs has been used on seedling and pre coning stands
Burning	Burning of standing trees or windrowed slash

Photo 7: Aerial application of herbicide by wand: Photo: DOC

5.7.2 Herbicides for wilding conifer control

Table 2: Herbicides for wilding conifer control describes the current herbicides available to managers of wilding conifer control programmes:

Table 2: Herbicides for wilding conifer control

Herbicide	Description of use	Target Species	Cost[6]
X-Tree ©	Used for single tree treatment and applied by hand with drench gun or wand from helicopter.	All conifers	$1-$500 / ha (depends on density)
TDPA[7]	Used for boom spraying of dense stands at a cost of $2200 / ha	Pinus spp	$2200/ha
Diquat (Reglone & Dyquat)	Used for boom spraying of conifers at moderate density & < 1m tall from the air or ground	Pinus spp and larch (not D. fir)	$600/ha
Metsulfuron	Used for boom spraying of conifers from the air	Larch and D. fir only	$500 - 600/ha

Trials are also underway to test improvements to TDPA[7] which might reduce the cost to $1700 per ha.

5.7.3 Factors for determining control method

The method for control of wilding conifer spread**Error! Bookmark not defined.** is determined by a number of factors including:

- Species of conifer
- Extent and density of infestation
- Age and size of wilding conifers
- Access and geographical nature of the site
- Values of the site and surrounding area (natural, landscape, farmland)
- Economies of scale
- Landowner desires

The control method needs to be chosen based on these factors first and then take into account current best practice methodology and the most cost effective option. The use of more expensive control options on larger areas is not realistic given the significant scale of the problem in the MWCM Zone.

[6] Prices current January 2016
[7] **T**riclopyr **D**icamba **P**icloram **A**minopyrallid

6 Management Units: Descriptions, priorities and costing

The implementation of this strategy is based on a series of 23 Management Units and 4 Sub Zones which have been used to enable prioritisation between large but similar affected areas of land against each other.

6.1 Descriptions

Each Management Unit has been described in three parts under Section 9 (p. 73) of this strategy:

6.1.1 Tree data (and costings by MU)

Refer to Table 15 (p. 77).

- 11 categories of data from the mapping system including total area of MU, area affected by spread, species and age category
- the seed source type based on a range of Isolated to Major (see Table 5)
- management approach as per the national approach (see Table 3)
- initial management based on a range from Removal of Seed Source to Containment (see Table 4).
- costs of initial treatment calculated from density of spread under 8 categories (see Table 12)

6.1.2 Description of productive and natural values (with scoring)

Refer to Table 16 (p. 80)

- description of the natural values at risk
- description of the productive values at risk
- LENZ threat category
- scores for LENZ, Susan Walker evaluation and Productive value

6.1.3 Proposed management (for each MU)

Refer to Table 17 (on page 87)

- Current management
- Proposed management
- Risks of control
- Potential followup
- Removal and containment priorities

6.2 Prioritisation criteria for ranking MU's

6.2.1 Criteria

The following table (Table 3) outlines the standard management approach categories (as per NZWCMS (MPI, 2014)) which have been used for the MU's:

Table 3: Management Approach

Management approach	Characteristics
Exclusion	Zero or low density, high value of land's current state, cost-effective to exclude, risk of invasion.
Eradication	Ability to remove all individuals, low-risk of reinvasion, ability to recover site to desired outcome, an area which benefits.
Progressive containment	Defendable boundaries, feasible to remove sources or stop further spread, long-term funding for knockdown and ongoing maintenance.
Sustained control	Integrated pest management outcomes, externality impacts, widely distributed, long-term funding commitment, occupies almost all suitable habitat.

In addition to the Management Approach Table 4 describes the initial management approaches that have been used for each MU. This enables a better ranking between those MU's that might be in the same classes for "Management Approach".

Table 4: Initial Management Categories

Initial Management	Characteristics
Remove spread	Initial management is focused on removing spread
Remove Seed Source	Initial management is focused on removing seed sources
Containment	Initial and ongoing management is focused on containment at containment lines
Ongoing Landholder Management	Status of the MU is such that it is in a maintenance regime with no coning wildings or wilding seed sources

The following table (Table 5) outlines the "seed source" type rankings used to assist in ranking MU's. These provide some further detail on the nature of the coning trees and the potential quantities of seed being produced by various MU units. For instance, the Pukaki West MU with over 9000 ha of coning trees potentially produces somewhere between 0.5 - 18 billion seeds per annum (Lew, 2013). If the germination rate is 5 per cent, then potentially there could be somewhere between 33 -900 million seeds germinating each year.

Table 5: Seed Source Type

Seed Source Type	Characteristics	Example MU
Major	Large extensive coning wilding spread producing large amounts of seed	West Pukaki
Significant	Generally, an extensive coning site but often just developing or in isolated patches but may be infilling	Manuka Terrace
Moderate	Patches of coning trees over or on parts of a unit	Braemar
Low	Very low numbers of coning conifers if any or has recently been controlled for coners.	Ben Ohau North
Isolated	Clean or no known coning conifers	Aoraki

Photo 8: Eighteen billion seeds per year - at risk from the West Pukaki MU: Ruataniwha Conservation Park. Photo: R. Young

The following table (Table 6) outlines the LENZ threat system and the scoring system used to assist in ranking MU's.

Table 6: LENZ Threat Categories

Category	Criteria	Name	Category Score
1	<10% indigenous vegetation left	Acutely Threatened	6
2	10–20% indigenous vegetation left	Chronically Threatened	5
3	20–30% indigenous vegetation left	At Risk	4
4	>30% left and <10% protected	Critically Underprotected	3
5	>30% left and 10–20% protected	Underprotected	2
6	>30% left and >20% protected	Less Reduced and Better Protected	1

The following table (Table 7) outlines the productive grassland scoring system used to assist in ranking MU's. While a little subjective it allows a ranking to be ascribed to each MU based on the nature of the grasslands in a relatively simple manner.

Table 7: Productive grassland scoring system

Grassland Type	Score
Intensive cropping or irrigated pasture	5
Flat OSTD pasture or undeveloped	4
Hill country OSTD pastures	3
Hill country undeveloped	2
Mixture of scree, rock and snow tussock	1
No productive value	0

6.2.2 Conifer mapping, data and classifications

The conifers have been mapped by distribution, density, age category and spread risk class.

The wilding conifers updated as part of this mapping and their assigned spread risk for the MWCM Zone are listed in Table 8. These were decided after comparing other spread risk tables and discussion with field operational staff.

Table 8: Wilding conifers and spread risk

Conifer species	Other Names	Spread Risk Classification
Pinus contorta	Lodgepole pine, Contorta	Very high
Pinus sylvestris Pinus nigra Pseudotsuga menziesii Pinus mugo	Scots pine, Baltic pine Corsican pine Douglas fir, Oregon Mountain pine	High
Larex decidua	Larch	Moderate
Pinus ponderosa	Ponderosa pine	Low

Table 9 describes the density classes used in the mapping and data for this report (which follows the national standard for dense, moderate and sparse (MPI, 2014)). Scattered outliers is the fourth class used in this strategy purely for differentiating low spread levels for costing purposes.

Table 9: Density classes

Density	MCWC Strategy Description	NZWCMS Description
Dense	>400 stems / ha	>400 stems / ha
Moderate	20 - 400 stems / ha	20 - 400 stems / ha
Sparse	1 - 20 stems / ha	0.01 - 20 stems / ha
Scattered outliers	< 1 stem / ha	NA

Table 10 describes the age classes used in the data and mapping for this report. Again as per the national standard.

Table 10: Age classes and descriptions

Age category	Description
Coning	Trees with cones producing seed
Pre- coning	Between seedling and coning stages.
Seedlings	Less than 1 metre in height or less than 2 years old

6.3 Ranking of Management Units and Sub Zones

The Management Unit data was entered into an Excel spreadsheet and rankings have been prioritised by a number of different criteria to sort out their importance within the MWCM Zone.

The following criteria were used:

- Natural and landscape values – the values as described in Table 16 (p. 80) for each MU.
- Land Environments of New Zealand categories by simply ranking them on the basis of the number of threated categories present in each MU.
- Susan Walker's ranking of ecosystems across parts of the Mackenzie. This ranked the MU's which are within the core intermontane parts of the basin.
- Productive values as described in Table 16 (p. 80) for each MU.
- Productive value based on a simple scoring system ranging from 0 to 5 based on productive value from nil to intensive farmland.
- Percentage of the MU affected by conifer spread – based on the extracted mapping data.
- Cost of initial treatment based on Table 12 (p. 36).
- Area of Public Conservation Land as an indicator of protected lands at risk.

By using various combinations of these criteria the following table (Table 11: MU site rankings by criteria) was produced. The cell colour relates to the four different Sub Zones the MU ended up being in at the end of the process. This was used as part of the process to assess the sub-unit priority rankings. For instance the blue cells which are Sub Zone 1 (East) ranked higher on many different criteria and combination of criteria.

This ranking is not absolute and the complexity of the issues requires some final ranking decisions based on experience and personal knowledge.

MU site rankings by criteria

Rank	LENZ	Susan Walker (SW)	Cost (Low-High cost)	Productive Value (PV)	Percentage affected by conifer spread low -high (%)	LENZ SW % PV Cost	LENZ % Cost	Area of PCL Ascending	Area of PCL Descending
1	Central Mackenzie	Grays Hills	Aoraki	Central Mackenzie	Aoraki	Grays Hills	Grays Hills	East Pukaki	Aoraki
2	Grampian Glenrock	Central Mackenzie	Motuariki	Grays Hills	Ben Ohau North	Central Mackenzie	Grampian Glenrock	Pukaki River	Burnett
3	Grays Hills	Braemar	Ben Ohau North	Braemar	Twizel Town	Grampian Glenrock	Central Mackenzie	Tekapo River	Ben Ohau South
4	Benmore Range	Twizel Flats	Pukaki River	Two Thumb	Grays Hills	Benmore Range	Benmore Range	Manuka Terrace	Two Thumb
5	Braemar	Hall-Haszard	Twizel Town	Benmore Range	Twizel Flats	Braemar	Twizel Town	Motuariki	Ben Ohau North
6	Hall-Haszard	Benmore Range	Tekapo Town	Twizel Flats	Two Thumb	Twizel Flats	Twizel Flats	Grampian Glenrock	Hall-Haszard
7	Twizel Flats	Grampian Glenrock	Tekapo River	Grampian Glenrock	Grampian Glenrock	Hall-Haszard	Hall-Haszard	Burke	Mount Cook
8	Twizel Town	Aoraki	Manuka Terrace	East Pukaki	Hall-Haszard	Twizel Town	Braemar	Twizel Town	West Pukaki
9	Ben Ohau South	Motuariki	Two Thumb	Burke	Central Mackenzie	Tekapo Town	Tekapo Town	Ohau River	Braemar
10	Tekapo Town	Ben Ohau North	Grays Hills	Hall-Haszard	Tekapo Town	Ben Ohau South	Ben Ohau South	Tekapo Town	Twizel Flats
11	Burke	Pukaki River	Burnett	Mount Cook	Burke	Two Thumb	Two Thumb	Central Mackenzie	Benmore Range
12	East Pukaki	Twizel Town	Benmore Range	Ben Ohau North	Benmore Range	Burke	Burke	Grays Hills	Grays Hills
13	Ohau River	Tekapo Town	Twizel Flats	Ohau River	Burnett	Ohau River	Ohau River	Benmore Range	Central Mackenzie
14	Tekapo River	Tekapo River	Grampian Glenrock	Ben Ohau South	Manuka Terrace	East Pukaki	East Pukaki	Twizel Flats	Tekapo Town
15	Two Thumb	Manuka Terrace	Hall-Haszard	West Pukaki	Ohau River	West Pukaki	West Pukaki	Braemar	Ohau River
16	West Pukaki	Two Thumb	Central Mackenzie	Tekapo Town	East Pukaki	Tekapo River	Tekapo River	West Pukaki	Twizel Town
17	Manuka Terrace	Burnett	Braemar	Tekapo River	Ben Ohau South	Manuka Terrace	Manuka Terrace	Mount Cook	Burke
18	Mount Cook	Burke	Burke	Burnett	Mount Cook	Mount Cook	Mount Cook	Hall-Haszard	Grampian Glenrock
19	Ben Ohau North	Ohau River	Ohau River	Motuariki	West Pukaki	Ben Ohau North	Ben Ohau North	Ben Ohau North	Motuariki
20	Burnett	Ben Ohau South	Ben Ohau South	Aoraki	Braemar	Burnett	Burnett	Two Thumb	Manuka Terrace
21	Pukaki River	East Pukaki	East Pukaki	Twizel Town	Motuariki	Pukaki River	Pukaki River	Ben Ohau South	Tekapo River
22	Aoraki	Mount Cook	Mount Cook	Pukaki River	Tekapo River	Aoraki	Aoraki	Burnett	East Pukaki
23	Motuariki	West Pukaki	West Pukaki	Manuka Terrace	Pukaki River	Motuariki	Motuariki	Aoraki	Pukaki River

KEY	Sub Zone 1 East	Sub Zone 2 South	Sub Zone 3 North	Sub Zone 4 West

Table 11: MU site rankings by criteria

6.4 Costing

Costs were calculated using the following categories of density and age as per this schedule. There are four basic categories of density and three basic coning categories. In order to get a more realistic costing the Sparse and Scattered were classified by age as well.

Table 12: Costings of wilding conifer control

Costing of wilding conifer control		
Density	**Age**	**Cost per ha[8]**
Dense	All	$2200.00
Moderate	All	$500.00
Sparse	Coning	$100.00
Sparse	Pre coning	$50.00
Sparse	Seedling	$25.00
Scattered	Coning	$10.00
Scattered	Pre coning	$5.00
Scattered	Seedling	$1.00

Costings have been calculated for each MU, totalled by Sub Zone, and totalled progressively based on the rankings by Sub Zone and Management Unit. (See Table 14 p. 74).

[8] Prices current January 2016

7 Strategic Goals, Objectives and Initiatives

7.1 Strategic 10 and 15 year goals

This strategy calls for bold action across an area of land that is regarded as iconic by many New Zealanders. It will require concerted and ongoing action on several levels to ensure the successful implementation on the ground over a timeframe of 10 to 15 years. The time for debate is over. Wilding conifers do not have a place in the South Island high country and the Mackenzie is one part of the South Island where it is still feasible to change the course of this weed invasion.

The goals for this strategic approach are split into 10 year and 15 year time frames. The rationale for dividing this into two stages is that while the removal of P. contorta from the areas outside West Pukaki MU is very achievable inside 10 years, it is doubtful given the complexity of the land ownership and size of the problem in the West Pukaki MU, that it is realistic to get to zero density over a 100 per cent of the zone in 10 years.

10 year goal

By 2026 the MWCM Zone has zero density P. contorta across all management units other than West Pukaki and all other wilding conifers outside this MU are under a surveillance and secondary control regime.

15 year goal

By 2031 the MWCM Zone has zero density P. contorta across all Management Units including West Pukaki and all wilding conifers inside the MWCM Zone are under a surveillance and secondary control regime.

7.2 Strategic Objectives and Initiatives

There are 10 Strategic Objectives as outlined in the Strategy. The pathway to achieving them has been set out as a series of Strategic Initiatives under each objective in Section 8.

8 Implementation of the Strategic objectives

8.1 Strategic Objective 1: Clarify roles and responsibilities and coordinate the programme

Determine and confirm the roles and responsibilities of the agencies, landholders and other organisations and ensure coordination between agencies and landholders to achieve maximum efficiencies.

For any effective management of wilding conifers on a scale of the MCWM Zone role clarity for all those involved is essential. It is also important that those involved respect the roles of others and work collaboratively to achieve the strategic outcomes in a timely, cost effective and efficient manner. The relationships of the parties are illustrated in Figure 5 (p. 40).

8.1.1 Role clarification

The roles outlined below are adapted from the NZWCMS.

Central government agencies including DOC, LINZ and Defence are well placed to:

- provide linkages to national leadership, including working with the NZWCMG to provide oversight of strategy implementation;
- contribute to the management of legacy infestations on the basis of the wider public good benefit, and as a land occupier for Crown-administered land;
- oversee operational control on Crown-administered land;
- promote consistency and alignment of legislation;
- co-ordinate research to improve management tools and best practice;
- comply with regional pest management plan "good neighbour" rules under the Biosecurity Act 1993.

The Canterbury Regional Council (ECAN) is well placed to:

- provide leadership at the regional/local level;
- enable wilding conifer control in regional plans;
- facilitate the development of control plans;
- co-ordinate control operations where multiple parties are involved;
- contribute to the management of legacy infestations on the basis of the public good benefit to regional/local communities;
- establish appropriate rules in regional pest management plans to ensure that land occupiers are undertaking their roles as outlined below;
- remove wilding conifer source plantings and spread on land administered by the Council.

The Mackenzie, Waitaki and Waimate District Councils are well placed to:

- contribute to the management of legacy infestations on the basis of the public benefit to local communities;
- establish appropriate rules in district plans to ensure that land occupiers are undertaking their roles as outlined below;
- remove wilding conifer source plantings and spread on land administered by the Council;
- promote awareness and support community initiatives.

Land occupiers and land managers are well placed to:

- avoid high risk plantings in high spread risk areas, and manage spread from conifer plantings on their land where that spread is or will impact neighbouring land;
- draw on best management practices (and industry standards) in planting and managing sites with the potential for spread;
- work collaboratively with local government, central government and neighbours to manage "legacy" wilding conifer infestations;
- take early action to remove wilding conifers received either by long distance wind dispersal, or following the removal of legacy infestations;
- support the management activities of a neighbouring conifer plantation by allowing access to control fringe spread;
- consider the management cost of a change in land-use which could increase the risk of spread, for example, retiring land from grazing effectively stops ongoing wilding conifer prevention;
- comply with any relevant legislation including regional pest management plan provisions under the Biosecurity Act, or any land-use rules under the RMA;
- meet principles agreed in any forestry accord developed through the implementation of this strategy.

Volunteers are well placed to:

- contribute to the management of legacy infestations;
- assist in taking early action to remove wilding conifers received either by long distance wind dispersal, or following the removal of legacy infestations;
- focus on areas where a visual result can be achieved in a timely manner for both the participants and to engender further public support for volunteer effort;
- advocate for public support for the case against the wildings.

The Mackenzie Wilding Conifer Trust is well placed to:

- provide governance and coordination for the MWCM Strategy;
- act as the forum for stakeholder participation;
- facilitate and co-ordinate the implementation of the MWCM Strategy;
- advocate and market the MWCM Strategy and its benefits to a wider audience;
- facilitate the development of annual operational plans;
- facilitate the bids to community funders for wilding conifer control;
- advocate for public support for the case against the wildings.

8.1.2 Establish a clear role for the Trust

The Mackenzie Wilding Conifer Trust needs a clear role that provides governance, strategic direction, operational and financial oversight and coordination and advice to the ongoing programme. It has a clear role in facilitating funding from other community sources. A review of other Wilding Conifer Trusts would be a beneficial exercise in the early stages of establishing the Mackenzie one.

The recent establishment of the Mackenzie Country Trust[9] provides an opportunity for working in tandem with an organisation that will have an interest in wilding conifer control.

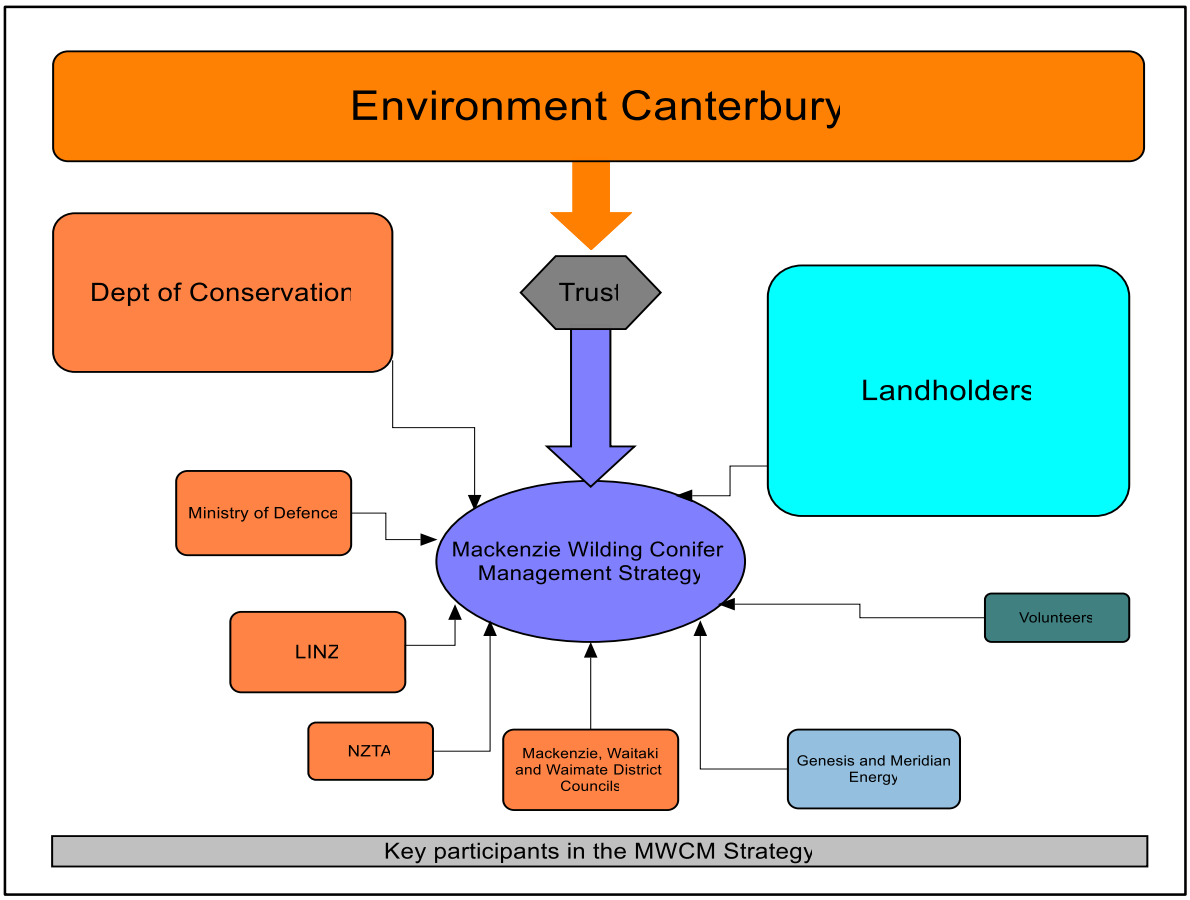


Figure 5: Key Participants in Wilding Management

8.1.3 Coordinate governance and operational control across organisations and agencies

Currently operational control is managed by several agencies and many landholders. While there is some level of liaison between all parties and the agencies meet on an annual basis to discuss and determine control plans for all weeds, there probably needs to be a clearer focus on wilding conifer problem and a higher level of interaction than in the past if this strategy is to be successful. The Mackenzie Wilding Conifer Trust will provide a vehicle for both governance and operational coordination across the MWCM

[9] The Mackenzie Country Trust was formed in February 2016 and aims to enhance the protection biodiversity and landscapes in the lowland Mackenzie Basin.

Zone. Agencies and landholders will need to fit their programmes in to the bigger picture of this strategy. The Trust will need to ensure that a MWCM Zone annual operational plan is developed and funded in accordance with this strategy.

8.2 Strategic Objective 2: Funding

Secure additional funding to undertake the implementation of this strategy and allocate the costs and expenditure in accordance with best practice and the key principles of wilding conifer control.

8.2.1 Secure significant additional resources for wilding conifer control in the MWCM Zone within 12 months

The full implementation of this strategy requires additional funding on top of the current annual funding available through individual landholders and agencies. The current scope of work (based on the current annual expenditure of $2.2M) cannot be stretched without significant innovation or a substantial increase in funding. While other choices can be made about how to use this current funding the hard fact is that this will mean gains will be made in one priority area and losses will be made in another. Hard choices will need to be made based on the current total funding available on an annual basis until the tranching of funding over a longer time frame is known.

As a first priority maintenance of the current levels of effort and funding is vital to the success of the strategy. Any further reductions in this base level funding will mean there will be further losses of areas to wilding spread. The recent history of declining Vote Conservation funding for wilding conifer control is not a sustainable policy. The hard won efforts of the last two decades of progress will again be lost. This runs counter to the strong evidence that has been produced about the importance of wilding conifer control and maintaining conservation values (Stephens, 2003) (Science and Research Unit, Department of Conservation, 2001).

Notwithstanding this the current level of resource is clearly completely insufficient to deal with the problem as outlined in section 4.1 and in Figure 3. The immediate need to get more resources for this wilding conifer problem cannot be over emphasised. Left for much longer the problem will become intractable and the iconic Mackenzie Basin landscapes and the many other values outlined in Section 5.2 will be lost.

The potential key sources for additional significant funding to enable this strategy to be executed will be:

- central and regional government.
- regional and national trust and lottery funding.
- philanthropic funding.

8.2.2 The funding needs to be adequate for the scale of the problem

The wilding conifer problem continues to grow both in size and cost and where you have a major seed source like West Pukaki MU the issue is massive.

A clear demonstration of the scale of the issue is shown in Figure 6 based on the Sub Zone 4: West which includes four MU's. The model has a starting cost of $15M in year 1 with various levels of annual investment to remove the conifers while the cost and scale of the

problem continues to escalate at 10 percent per annum. This rate of cost and area increase is probably too conservative for this zone with its huge seed source.

At the current estimated level of investment in this zone no traction is going to be made and the cost will continue to escalate. Progress will only be made in this zone by at least doubling the existing investment and even at that level it will take nearly 14 years to achieve control. However, by tripling the investment a result can be achieved in 8 years. This model shows how achievable the removal is with the right scale of investment and a containment programme in place.

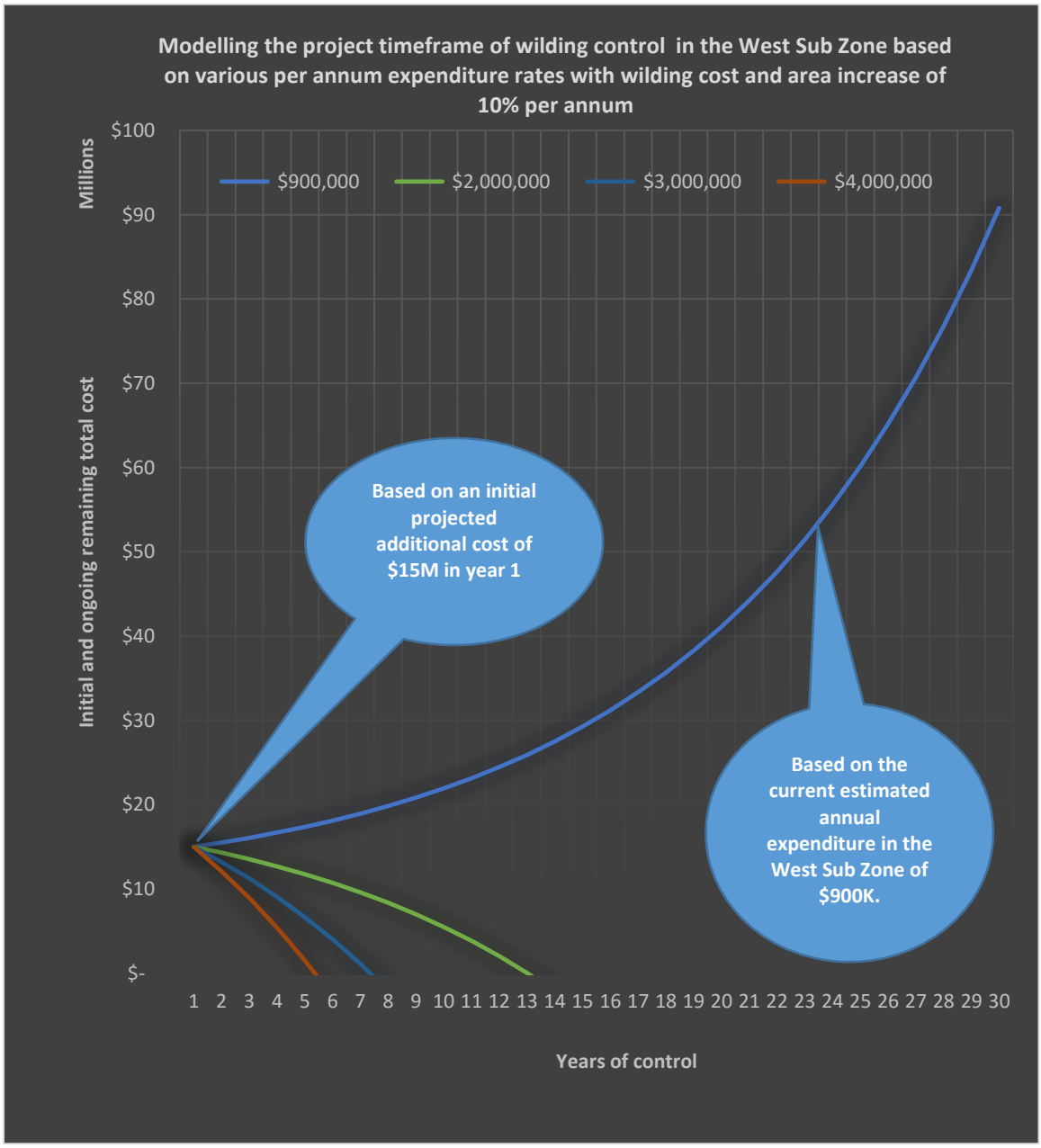


Figure 6: Model of projected cost of completing initial wilding conifer control in the West Sub Zone

8.2.3 Cost sharing amongst exacerbators and beneficiaries

Undertake the collective programme utilising the funding formula outlined in the NZWCMS (MPI, 2014). This is considered to be best practice and the way forward for the future funding of controlling wilding conifers. It is suggested as the "starting point." The summary table from this document is presented in Appendix 5: NZWCMS Cost Shares (p. 102). This funding formula is outlined in full in the NZWCMS in Appendices II and III.

8.2.4 Funding mechanisms

There are several ways in which the funds for this strategy could be managed. Models used in other places require pooling of all contributor funding under the Trust umbrella. Alternatively, each agency could maintain responsibility for its own funding but expend it so it fits the strategic and annual plan priorities. This is similar to the current approach that ECAN and DOC use for ECAN funds.

The decision about the funding mechanism is potentially complex with numerous agencies and many landholders involved across the MWCM Zone. It is an issue that needs to be discussed by the Trust and will require decisions by each agency Chief Executive if a complete pooling of funding is to occur.

The history of landholder rating systems in the Mackenzie does not have a good record (e.g. rabbits and wallabies) and any pooling system of landholder funds would need to be absolutely transparent.

Whatever model is chosen for funding management needs to ensure that:

- The priorities outlined in this strategic plan are undertaken in a logical order.
- Accountability to each contributor is maintained.
- Funds are expended efficiently.
- It retains flexibility so it works for all contributors.
- Enables easy coordination of the annual plan.

8.2.5 Apply the key funding guidelines to every funding decision

There are several key guidelines which relate to the total funding and tranching of the funding for wilding conifer control:

- A stitch in time – the obvious rule of all conifer removal work. It will not get cheaper the longer it is left.
- Front end the investment – it is better to start with a large investment in the early years rather than the other way around. The impact of hitting a major seed source or any significant infestation with enough funds is vital to make a significant initial impact and avoid the escalating cost of control once started.
- Ensure the landholders who are participating in each annual plan are able to fund their share of the work and the proportion of the cost borne by the landholder is realistic in terms of the economics of the farm operation. The formula provided in the NZWCMS (MPI, 2014) is a basic starting point for this cost share approach, however some of the more significant problems may need a different approach. The MPI funding cost sharing summary is provided in Appendix 5 (p. 102).

- Avoid stop-start – the “Kirkliston” effect – this is a major infestation in the Hakataramea Valley that has been started and stopped or slowed down several times over time. The earliest efforts to control this area took place in the 1980s under Lands and Survey and then stopped. The project was restarted in the ‘90s under DOC but again the funding varied and it is only finally being completed now. In total, control for this small core area has taken nearly 40 years with considerable repeat efforts and significant cost escalation.
- Follow-up funding is vital and needs to be built into the total cost until the area is handed back to the landholder (see Section 8.6).

8.3 Strategic Objective 3: Implementing the work programme

Implement the programme utilising best practice, annual planning and professional and experienced contractors.

8.3.1 A coordinated annual plan is developed each year for the MWCM Zone

The participants in this strategy need to collectively develop an annual plan each year for undertaking the operational work based on the priorities and information in this strategy. This annual plan needs to be structured around key targets and reported on at the end of each annual operational period.

8.3.2 Undertake the work utilising professional experienced contractors

The work of wilding conifer management has become much more technical and highly skilled in the last decade. It is absolutely vital that this work is undertaken by skilled contractors and staff. This work has many risks with the use of various tools (helicopters, chainsaws and herbicides). Under the provisions of the new Health and Safety at Work Act 2015 this type of work will be at the higher end of the spectrum in terms of risk.

Any proposals to utilise unskilled labour in this work as a potential training ground should be avoided. The history of wilding conifer control is littered with failed examples of this type of staffing which in the end is costly and has much higher risks.

8.3.3 Capacity of the workforce

While most of the current professional workforce is highly capable the significant limiting factor if there is a significant funding boost will be the availability of enough contractors. This will be a national issue which needs a clear strategy to ensure it is not an ongoing issue. Initially there may need to be a ramp up approach with the quantity of work made available.

At a regional level consideration needs to be given to how this capacity issue can be addressed. Failure to address this has two risks:

- the work won't be able to be completed in time.
- tender prices could get escalated if there is more demand than supply of contractors.

8.4 Strategic Objective 4: Distribution and monitoring of the extent of wilding conifers

Determine the complete distribution of all wilding conifers and undertake ongoing monitoring of the distribution within the MWCM Zone.

8.4.1 Undertake a survey of all isolated legacy seed sources

The process undertaken to develop this strategy included updating the ECAN mapping data from 2013. Given that this update relied on personal conversations with over 50 landholders and managers there will be some level of variability in the data collected. Some validation was carried out with field checks, aerial photos and using Google Earth. However, this data should be regarded as a snapshot in time. While not likely to be 100 per cent accurate, based on the 80/20 principle it is a robust enough for making prioritisation decisions.

Aside from this there is one part of the data which is clearly lacking in accuracy and is critical to its success. While undertaking these interviews and field observations it became apparent that there are numerous shelter belts and copses of trees containing the two most spread prone species of P. contorta and P. sylvestris that have not been identified. It has not been possible within the parameters of this project to inspect all of these potential seed sources and in many cases landholders are not familiar with the Pinus species to distinguish some of the more similar ones from one another.

In order to get a complete picture of these key isolated legacy seed sources there are two potential options which would provide the data to fill this data gap:

1. Option 1: This is a more traditional approach and requires the employment of temporary staff (suggest a forestry student) to undertake an inspection of all these shelter belts, isolated copses and outliers which may contain very high vigour spread species, i.e. P. contorta and P sylvestris. Most of these sources would be accessible by 4WD vehicle. Many of them have been recorded in the data base and mapped as plantations, shelterbelts etc. Of the 53 properties covered by the survey 47 have shelterbelts or planted forests or both. In total there are 705 planted type polygons in the 2013 ECAN database. The estimated cost of this option is $35,000-$40,000.

2. Option 2: The second option is more “blue skies thinking” requiring the use of modern technology. It involves flying the whole MWCM Zone with a fixed wing plane and surveying it in a grid pattern utilising remote sensing. Remote sensing can detect different plant species by using spectral chromagraphy and recording the results in a GIS system. While clearly more expensive than Option 1 it has several advantages including lack of human error and the ability to redo the process in several years’ time as a measuring and reporting tool. The cost of this option is undetermined at this stage.

8.4.1.1 Rationale

The rationale for this proposal is that without this information outlier spread will have to continue ad infinitum while these sort of seed sources continue to exist. Often they will only be a small group of trees but their effect is currently sitting under the radar.

This information will allow the identification and removal of all potential seed sources of these species. While collecting this information has cost attached to it, without it the approach to complete removal of these species is not able to be methodical and the outcome cannot be measured easily.

8.4.2 Establish an ongoing monitoring system for measuring the distribution of wilding conifers

In order to be able to manage the conifer spread issue it has to be measured; "you can't manage what you can't measure." Periodically it will be necessary to undertake monitoring of the current state of distribution of wilding conifers in the MWCM Zone in order to measure the success of the programme.

Information for this can be collected as wilding conifer control is undertaken and from landholders. However, the whole zone needs to be systematically covered periodically in order to ensure that the establishment of new sources is avoided or they are removed when they do establish.

8.5 Strategic Objective 5: Prioritise the removal, control and management of wilding conifers

Prioritise the wilding conifer control work by preventing, containing and removing spread with both species led and site led strategies.

8.5.1 Avoid the establishment of new sources of wilding conifers

The first priority action needs to be that new sources of wilding conifers and seeding conifers are not allowed to establish.

8.5.2 Ensure lands undergoing a change of use are "fit for purpose"

This is mainly related to actions by the Crown parties involved in tenure review. Lands that are going to be either made freehold or transferred to DOC should be clean of wilding conifers at the point of handover so that DOC does not inherit any more wilding conifer spread issues or seed rain from adjacent freehold land from this process.

8.5.3 Define and implement containment lines

Establish clear containment lines and map them for each major and significant seed source or infestation. These lines will be the holding lines for the intervening period before the seed source is eradicated. This is the period when the Management Unit or area will be under either "Progressive Containment" or "Sustained Control".[10]

These lines may follow the MU boundary (e.g. in the case of West Pukaki MU) or they could be a subset area of the MU (e.g. in the case of Burke MU).

8.5.4 Assess the risks and manage the "out of zone seed sources"

There are two groups of "out of zone seed sources"[11] which need to be considered when undertaking control of the wilding conifers in the Sub Zones and Management Units adjacent to them. Map 3: "Out of Zone Seed Sources" (p. 51) shows these seed sources which are not covered by this strategy but their potential effects on the adjacent zones pose a significant risk and their future management will need to be taken into account before committing any significant resource to eradication of other wilding conifers in the Management Units close to these seed sources.

The East "out of zone seed sources" are already providing seed to the Tekapo Saddle area in an easterly wind condition. There are two areas of this seed source in the Opihi and Opuha catchments.

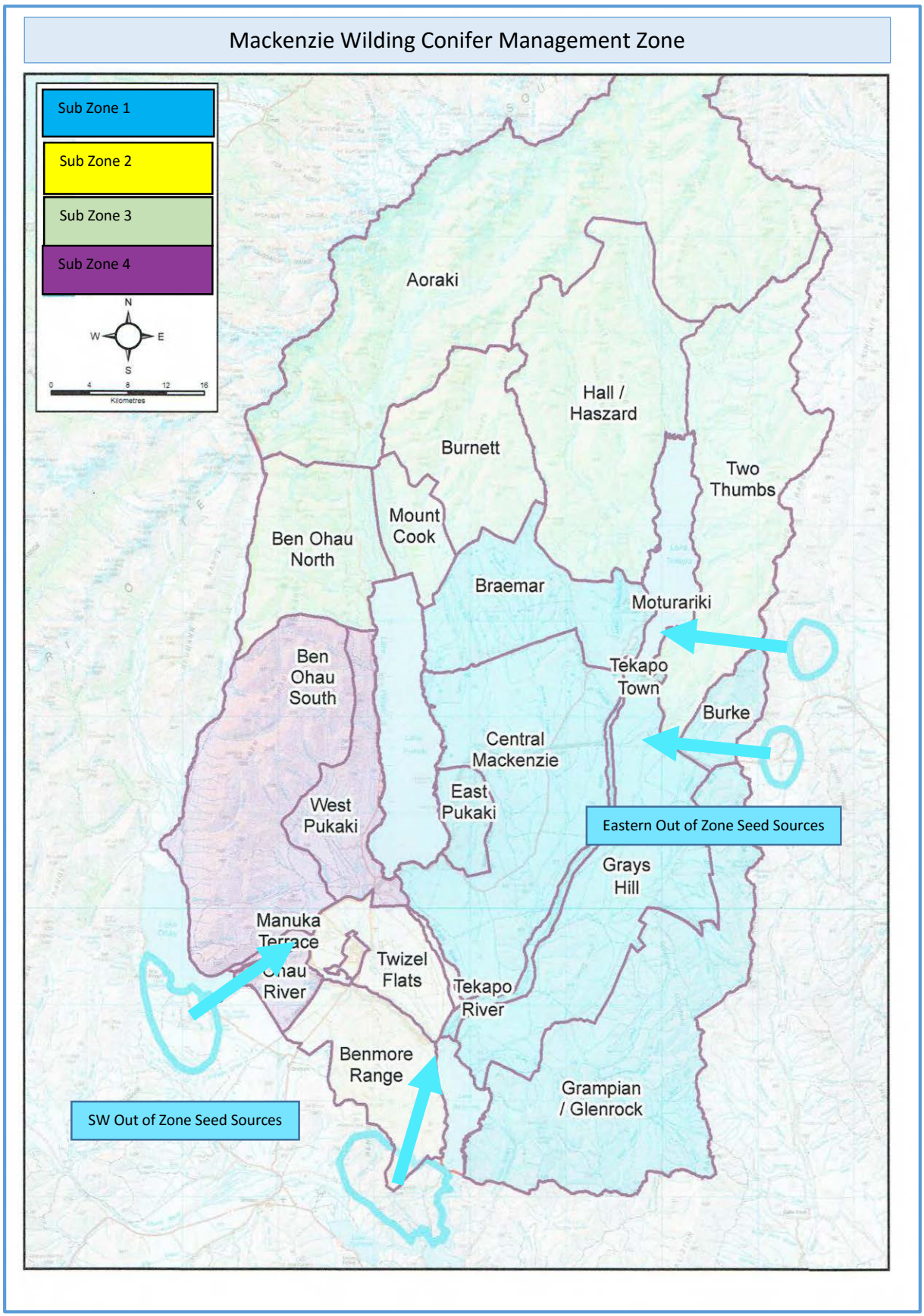
The other group is to the southwest of the MWCM Zone and will provide seed in southerly quarter winds. Again these two areas are close to the boundary of the MWCM Zone and without any control will become significant sources of re-infestation.

Some work has been undertaken in these areas in the past few years but wilding conifers of several age categories still exist across these "out of zone" areas. These "out of zone

[10] Refer to Table 3: Management Approach

[11] "Out of Zone Seed Source" is a mature wilding conifer seed source outside the boundary of the MWCM Zone

seed sources" have not been inspected as part of this process so need to be considered as part of the annual operational planning undertaken to implement this strategy.



Map 3: "Out of Zone Seed Sources"

8.5.5 Species and site led strategies

The strategy proposes two prioritisation systems and strategic approaches across all sites in the zone:

1. Species led - programme is primarily focused on removing species of wilding conifer.
2. Site led - programme is prioritised by site at both Sub Zone and Management Unit level.

8.5.6 Species led strategy for Pinus contorta and Pinus sylvestris across the whole zone.

The most significant wilding conifer threat in this strategy area is the species Pinus contorta known colloquially as "Contorta" or sometimes by its common name Lodgepole pine. It is proposed that a species led strategy be developed for reducing P. contorta and the less common but just as significant threat Pinus sylvestris (known as Scots or Baltic pine) to zero density in the MWCM Zone.

This species led strategy would eventually see all coning Pinus contorta eradicated and pre coning trees and seedling trees reduced to zero density from the zone over a 10-year period. The only area that may not be completed in this time is the West Pukaki MU.

There are several stages to undertaking this species led strategy.

The first step is outlined under Strategic Objective 4 and requires an accurate inventory of all isolated mature P. contorta, P. sylvestris, P. nigra and D.fir in the MWCM zone. While current inventories record the occurrence of wilding conifer spread there is no complete record of all shelterbelts and planted forests. They are currently recorded in the GIS system as a polygon, but often without complete data. In the case of 66 per cent of the 705 polygons the critical data of species type is missing.

The second step of this process would be to remove from all these isolated sites all the P. contorta and P. sylvestris within one year of completion of this inventory. While this still leaves the larger seed sources (which are all clearly identified now) across the zone it will remove these random seed sources which are potentially sources of ongoing seeding events in major windstorms. A systematic approach to monitor all these sites on a 4-5 return cycle should follow to ensure the sources do not re-establish. This could be part of a landholder's responsibility once the original removal is completed.

There are some sites that have been noted on an adhoc basis during the work undertaken for this report. Examples of these are the shelterbelts on SH8 near Haldon Road, Mackenzie District Council plantations at West Tekapo and Sandy Cutting, the pine forest on Motuariki and the Lake Tekapo Regional Park which all still currently contain P. contorta.

The third step is combined into the site led approach. This involves the systematic removal of all P. contorta and P. sylvestris as each site is managed to zero density. The diagram below summarises the process for the isolated legacy seed source sites:

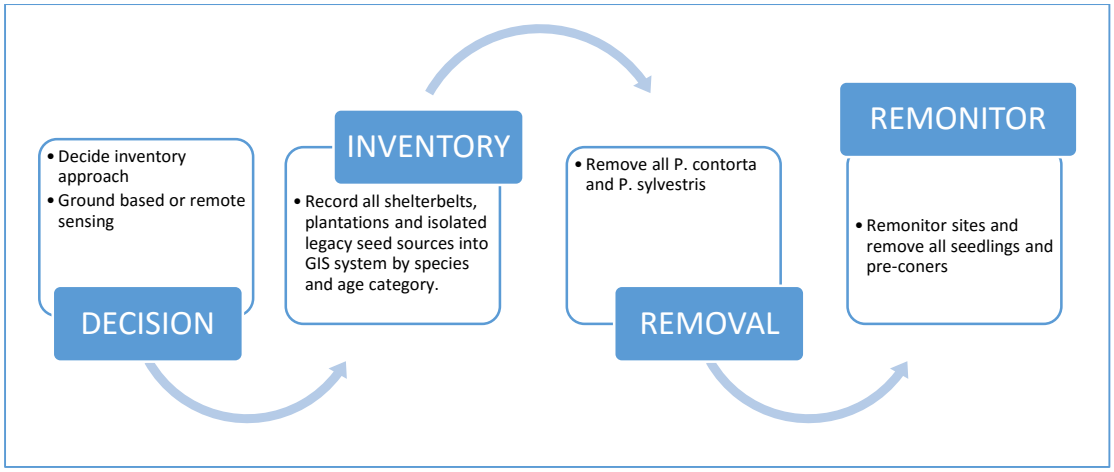


Figure 7: Process for P. contorta removal from isolated legacy seed sources

8.5.6.1 Rationale

The rationale for this approach is based on the significant threat posed particularly by P. contorta and to a lesser extent P. sylvestris. However, if records are going to be made of these two significant threats then the other species with a high spread risk should be recorded as well.

8.5.7 Site led strategy

The MWCM Zone was divided into a series of 4 Sub Zones (SZ) and 23 Management Units (MU). These form the basis of the site led approach. Each MU has a description and has been analysed to provide the information for making rationale choices about prioritisation. The site led approach is based on treating each of these MU's as an individual site for gathering information and the detail of on the ground treatment. The MWCM Zone is divided into four sectors made up of these MU's which are described as "Sub Zones" and used as larger units for prioritisation.

The 23 Management Units and the boundaries were defined by using a range of criteria including:

- Seed source type
- Level of infestation of wildings
- Geography and LENZ threat categories
- Current level of control
- Property and geographic boundaries
- Proposed management of wildings

The 23 Management Units are:

1 Ohau River
2 Benmore Range
3 Twizel Flats
4 West Pukaki
5 Ben Ohau South
6 Ben Ohau North

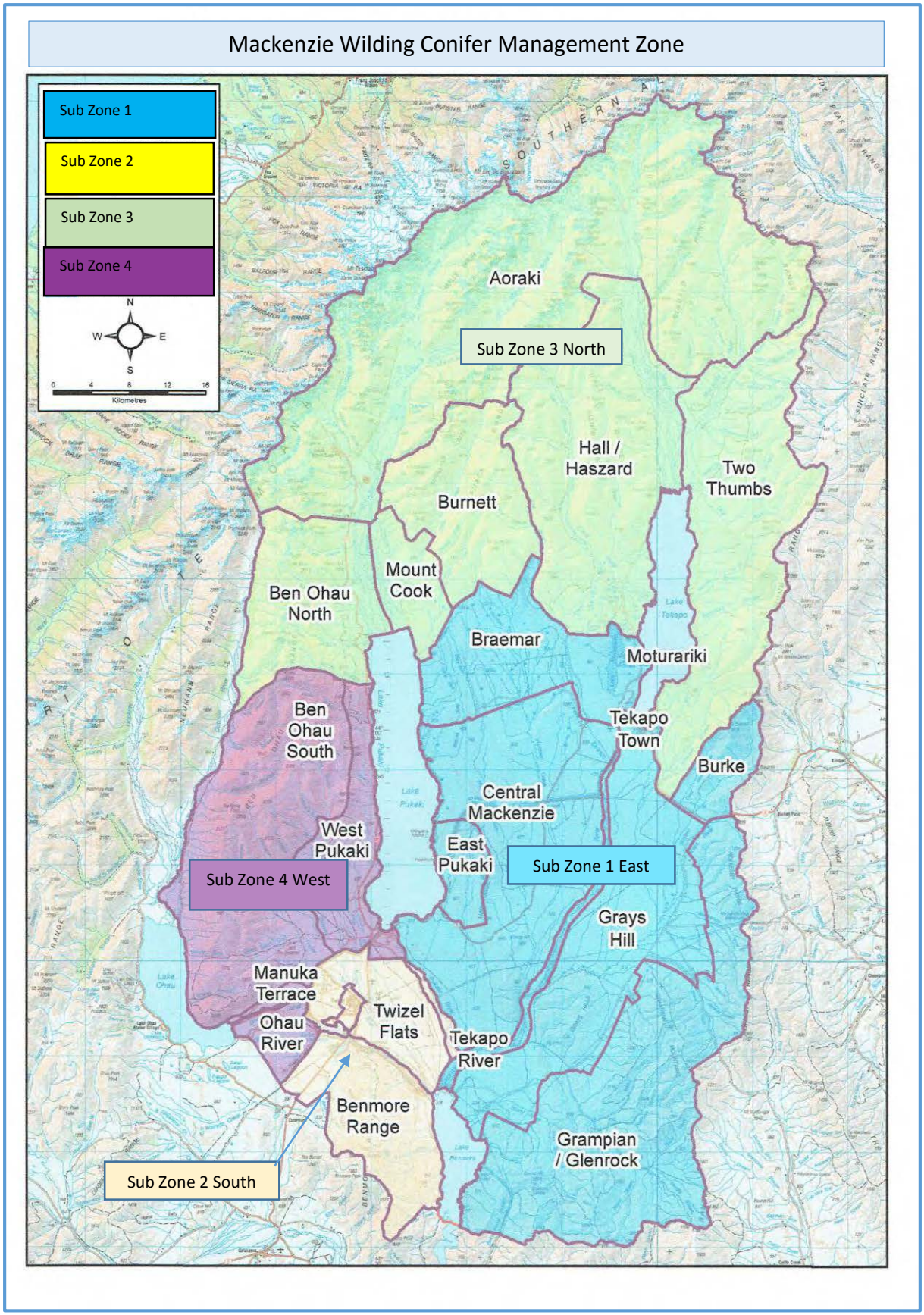
7	Aoraki
8	Burnett
9	Mount Cook
10	Braemar
11	Hall / Hazard
12	Two Thumbs
13	East Pukaki
14	Central Mackenzie
15	Burke
16	Pukaki River
17	Tekapo River
18	Grays Hill
19	Grampian / Glenrock
20	Twizel Town
21	Tekapo Town
22	Manuka Terrace
23	Moturariki

The second volume of this strategy the "Maps for the Mackenzie Wilding Conifer Management Strategy" contains the maps relating to each Management Unit.

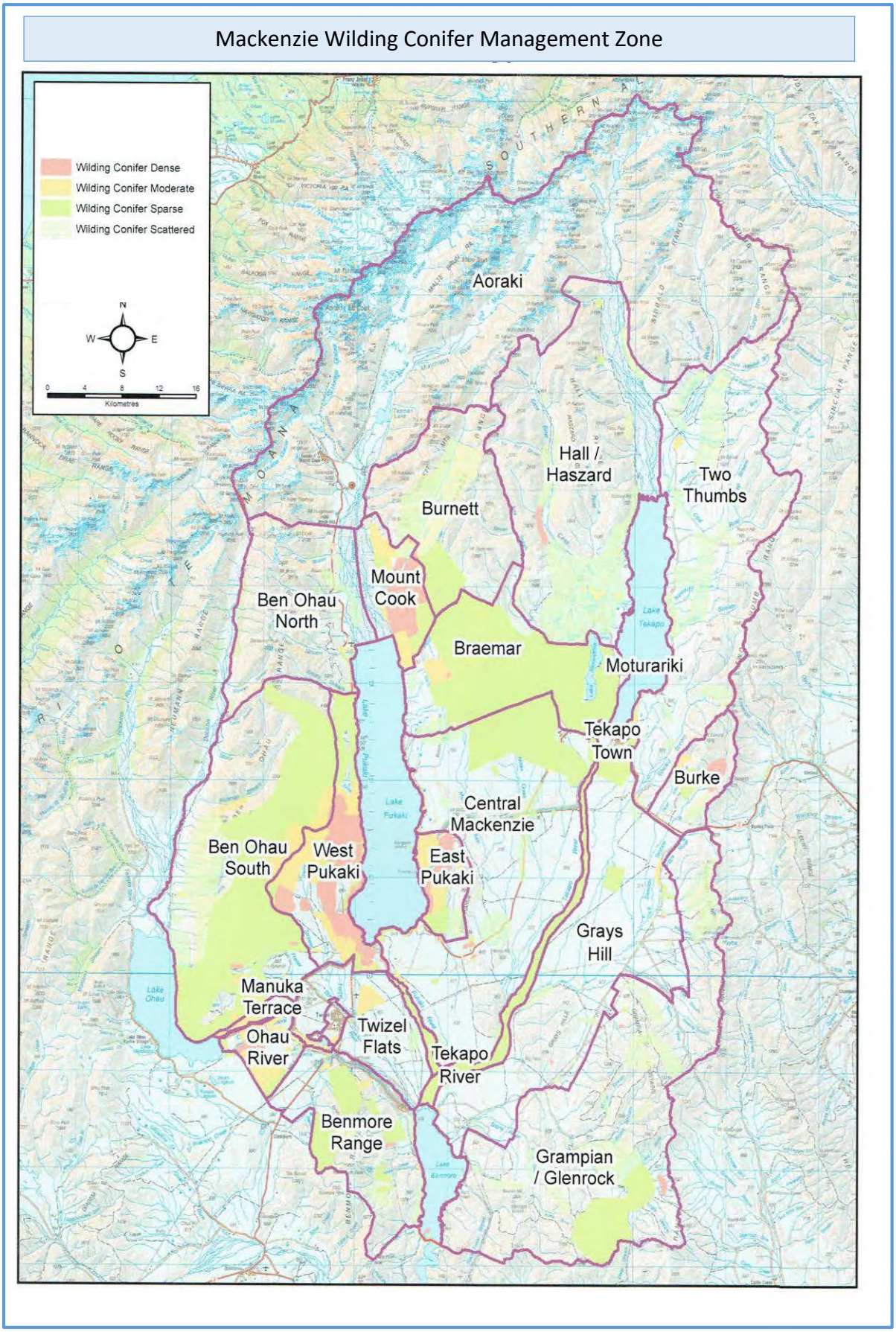
The four geographic Sub Zones which are collectively made up of a number of MU's each are based on common elements across the landscape, geography, productive value and natural values. The Sub Zones and their colour codes are:

1. Sub Zone 1: East Sub Zone (blue)
2. Sub Zone 2: South Sub Zone (yellow)
3. Sub Zone 3: North Sub Zone (green)
4. Sub Zone 4: West Sub Zone (purple)

For simplicity the Sub Zones are numbered in the same order as they are prioritised for management and control.



Map 4: Sub Zone and Management Unit Boundaries



Map 5: Wilding Conifer Density and Spread

8.5.8 Prioritisation at Sub Zone level

The wilding conifer management work should be prioritised across these four Sub Zones initially.

The four Sub Zones in priority order are:

Priority 1:

Sub Zone 1 East: Eastern sector of the MWCM Zone containing the Braemar, Central Mackenzie, Grampian-Glenrock, Grays Hills, Tekapo Town, Tekapo River, East Pukaki and Burke MUs.

The rationale for this Sub Zone being the top priority is that it has:

- Relatively low levels of conifer infestation outside the two major seed sources of East Pukaki and Burke MU's.
- Contains a significant area of productive land which is currently being treated by landholders reasonably successfully but remains under threat from the two major seed sources of East Pukaki and Burke.
- There has been considerable previous investment in parts of this zone by both landholders and agencies and currently it seems to be reasonably successful with limited regrowth.
- It contains many MU's with a high level of natural values based on Land Environments of New Zealand (LENZ) threat categories and an independent assessment undertaken by Susan Walker, Landcare Research. These areas are largely under-represented in any formal protection system.
- It protects an altitudinal sequence across the Mackenzie Basin.

Priority 2:

Sub Zone 2 South: Southwestern sector containing Benmore Range, Twizel Flats, Twizel Town, and the Pukaki River MUs.

The rationale for this sub – zone being the second priority is that it has:

- Relatively low levels of conifer infestation.
- Contains a significant area of productive land which is currently being treated by landholders with varying results but is definitely at a point where some investment now will reduce the future need for high cost work. It remains under threat from the two major seed sources of West Pukaki and Ohau River and to a degree from Twizel Township MU.
- There has been considerable previous investment in parts of this zone by both landholders and agencies and it would be wise to ensure this is not wasted.
- The Twizel Flats and Benmore Range score highly in relation to natural values based on LENZ threat categories and an independent assessment undertaken by Susan Walker, Landcare Research. These areas are largely under-represented in any formal protection system other than the Pukaki Flats CA.

- While the Ohau River and West Pukaki MU's which are both significant seed sources are on the northern boundary of the MU there are defendable boundaries where containment lines can be drawn to prevent the spread into the adjacent parts of the MU.

Priority 3:

Sub Zone 2 North: Northern sector containing Two Thumb, Motuariki, Hall Haszard, Burnett, Mount Cook, Aoraki and Ben Ohau North MUs.

The rationale for this Sub Zone being the third priority is:

- Relatively low or scattered levels of conifer infestation in five of the seven MU's which make up this Sub Zone.
- Contains a smaller area of productive land which is currently being treated by landholders and managers with success but could do with some investment to remove all coning trees and some isolated seed source trees. It remains under threat from the major seed source at Mount Cook MU but the work undertaken on three large bordering properties in the Braemar MU (part of the Sub Zone 1: East) has now created a defendable containment line along and around the southern boundary of the Mount Cook MU.
- There has been considerable previous investment across all the MU's (except for the major part of the Mount Cook MU) in this zone by both landholders and agencies and it would be wise to ensure this is not wasted.
- The spreading conifers are mainly P. nigra and Larch which are in the high and moderate spread risk categories respectively. Neither of these species are as aggressive as P. contorta. While this does not mean land managers need to be less vigilant, the rate and density of spread is much more manageable.
- Most MU's in this zone have a lower level of natural values based on LENZ threat categories. However, the majority (84 percent) of the PCL in the MWCM Zone in this Sub Zone and part of the Te Wahipounamu South-West New Zealand World Heritage Area is within its boundary.

Priority 4:

Sub Zone 4 West: Western sector containing Ohau River, Ben Ohau South, Manuka Terrace, and West Pukaki MUs.

The rationale for this Sub Zone being the lowest priority is:

- Very high levels of conifer infestation in all four MU's (>57 percent) which make up this Sub Zone and a total level of infestation of 64 percent.
- Most of the spread is P. contorta and over 9000 ha of this spread is coning.

- The Sub Zone contains denser and moderate spread than all the other sub units together, in fact 3000 hectares more.
- The productive land is seriously affected by this dense and moderate spread and to a lesser degree the sparse spread which is now rapidly infilling. Eighteen per cent of the land is so infected it is now not productive or usable for any other purpose.
- There has been continued previous investment across three of the MU's in this zone by both landholders and agencies but at the current level of investment it is not going to work. However, the step change required to lift the investment to an effective level is significant. The current level of annual investment of between $800,000-900,000 in time and dollars is completely insufficient to make inroads into this nearly $15,000,000 problem. Based on the NZWCMS (MPI, 2014) figures the spread and problem in this sort of area is increasing at 5 per cent per annum in size and cost. To really make inroads and not just hold the line it needs to be increased to an investment of $2-4M per annum for 6 to 11 years (see Section 8.2.2 and Figure 6).
- Most MU's in this zone have mid-level natural values based on LENZ threat categories. However, 40 per cent of this Sub Zone is PCL with most of it contained in the Ruataniwha Conservation Park and has a high level of recreational use and a range of natural values and some threatened species.

Photo 9: Ohau River and Manuka Terrace MU's: Photo: R. Young

8.5.9 Priority actions for site led management across Sub Zones and within Management Units

1. As a minimum, maintain existing levels of surveillance and secondary control across each Sub Zone.
2. Establish containment lines around the MU's which are identified as major seed sources and prevent further seed spread establishing to coning age beyond those lines. In some situations, this is going to require ongoing annual expenditure until that MU becomes a top priority.
3. Remove all scattered outlier conifers before coning age within each Sub Zone outside of the major seed source MU's.
4. Undertake the removal of all coning conifers outside of the major seed source MU's and subsequent progressive removal of all preconing and seedling conifers across the four strategic Sub Zones in priority order.
    - Remove remaining isolated small and moderate size coning stands in MU's with high vulnerability to invasion outside of the major seed source MU's.
    - Remove all sparse and moderate pre coning spread in MU's with high vulnerability to invasion outside of the major seed source MU's.
    - Remove remaining isolated small and moderate size coning stands in all other MU's outside of the major seed source MU's.
    - Remove all sparse and moderate pre coning spread in all other MU's outside of the major seed source MU's.
5. Undertake the removal of all the conifers from the East Pukaki, Burke and Ohau River major seed source MU's based on the ability to fund the complete removal of each seed source and provide subsequent secondary control.

8.5.10 Undertake assessment of "quick wins"

Quick wins are described as a spread removal project that can achieve a visual result in a short time with minimum expenditure. There are no "quick wins" at a Sub Zone scale. At an MU scale there is one MU categorised for spread removal that can be achieved for less than a $100,000. This is Ben Ohau North at $22,740 (see Table 13: Quick Win Projects).

There are some other small seed source removal projects which can also be achieved for less than $100,000, but they are not high priority projects if the basis of the quick win is on spread removal and neither would they be visual.

There are a further two spread removal projects at an MU level that can be achieved for under $150,000. They are both ranked at priority 2 inside the Sub Zone, Grays Hills at a cost of $135,825 and Two Thumb at $120,925.

Mackenzie Wilding Conifer Management Units Quick Wins

Sub Zone	Management Unit	Priority within sub zone for removal funding	Total Area of MU	Total Area affected by conifer spread	Percentage affected by conifer spread	Main Species	Other Species	Coning	Dense Area	Moderate Area	Sparse Area	Scattered Outliers Area	Total Area	Estimated cost of initial treatment of MU
3	Ben Ohau North	4	22626	1040	5%	L dec	P syl	Pre-coning	0	30	102	908	1040	$ 22,740
3	Two Thumb	2	44823	7113	16%	P nig	P con	Coning	5	126	13	6968	7113	$ 120,925
1	Grays Hills	2	38733	2478	6%	P con	P nig	Coning	21	83	1456	919	2478	$ 135,825

Table 13: Quick Win Projects

Density of conifer spread across the MWCM Zone

Conifers are spread across 129,000 ha of land in the MWCM Zone ranging in density from dense to scattered outliers (refer to Table 9: Density classes p. 33). Figure 8 below shows the percentages of density by area. Dense and moderate areas cost between $500-2200 per ha to remove. However, with a total of 84 per cent of the area affected by sparse and scattered outlier spread and at a cost of between $1-100 per ha intervention now will save significant costs in the future. The cost of the clearance of this 84 per cent is $3. 3M or 12 percent of the total of the additional funds required for the MWCM Zone. Delays in removing this sparse and scattered spread will result in increasing total cost for wilding removal in the MWCM Zone.

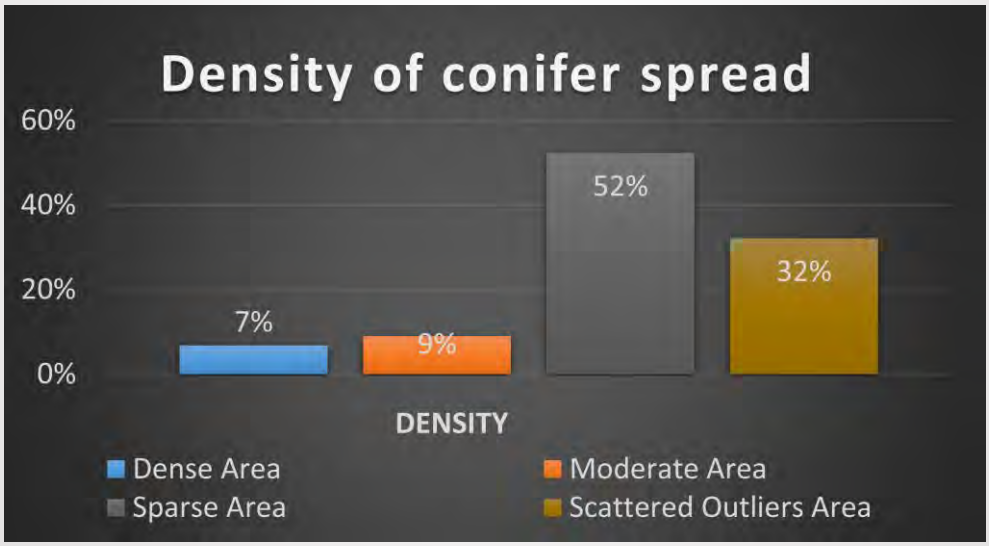


Figure 8: Density of spread across the MWCM Zone

8.6 Strategic objective 6: Post control management

Maintain effective post control and secondary management to ensure that conifers do not re-establish in areas where initial control has been completed.

8.6.1 Hand back after major control work to landholder

Once major work has been completed it will be necessary to hand back areas to landholders for ongoing control. Establishing an agreed timing, process and standard for such a handover will ensure a clear understanding by all parties and successful ongoing wilding conifer management.

8.6.2 Surveillance and control

All areas once treated need to be kept under surveillance and control to ensure that there is no further establishment of pre coning and coning conifers. Across significant areas of the MWCM Zone the current level of surveillance and control seems to be working well especially in most situations where the land is being managed by farmers. It is absolutely vital that this is maintained. Currently the expenditure and level of effort is on average $6900 per property (excluding the 2 large contributors) and an average of 23 person days per annum. Assuming the area affected by wilding spread does not expand any further beyond the 130,000 ha affected now then it is estimated that it will cost between

Lake Tekapo Scientific Reserve – why the increase in seedlings?

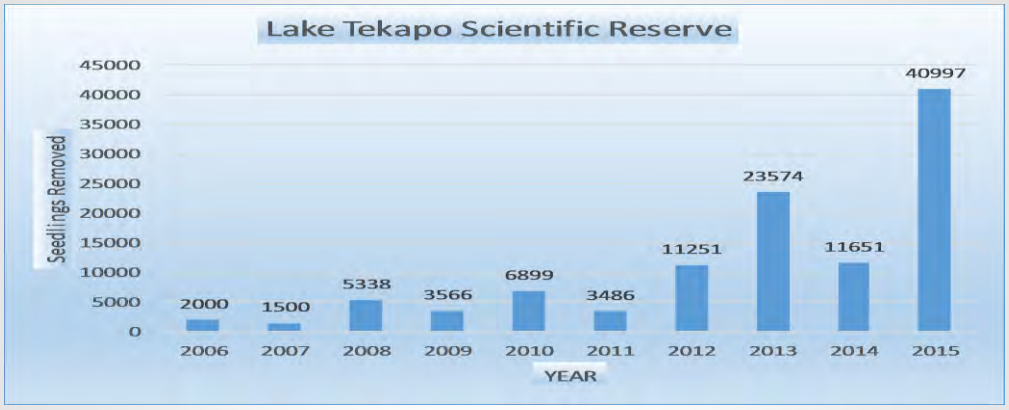


Figure 9: Annual conifer seedling removal at the Lake Tekapo Scientific Reserve

Tekapo local David Scott has maintained a record of the seedlings he has removed each year from the 1100 ha Lake Tekapo Scientific Reserve (managed by DOC) near Tekapo. Coverage of the whole reserve has been completed each year with the exception of 2014. There are no seeding conifers inside the reserve. The seed sources for the continuing and increasing level of invasion are within the adjacent plantations around lake Tekapo township and the Lake Tekapo Recreation Park. This shows the importance of ongoing surveillance and control and the need to remove all isolated seed sources.

$1,000,000 and $3,250,000 per annum to maintain a 4-year cycle over the MWCM Zone once the initial removal of seeding age wilding conifer spread is completed.

8.6.3 Establish a reporting mechanism to update the mapping information

The map project needs to be maintained as wilding conifer control is undertaken and new data is identified. A system for managing and updating this data needs to be established both amongst the agencies and to collect information from landholders. Agencies can easily share and provide updated information as they work through their annual work plans. However, another vital facet of this mapping information is the data collected from landholders. A system of annual return could be established whereby for each property current mapped conifer data and information is sent to each landholder and they are requested to update it and return it to the lead agency.

8.6.4 Grazing

Post control techniques vary and while maintaining surveillance and control regimes are essential, the use of specific grazing for after management is definitely used with a level of effectiveness by 24 per cent of individuals that were interviewed. Utilising these techniques in specific situations, for instance areas where coning conifers have been removed and high levels of regrowth can be expected would potentially reduce the cost and time involved in secondary control. Standard levels of grazing do not work.

Mob stocking, the use of fertiliser and other more favourable fodder crops are all tools that have been successfully used to mitigate the costs of secondary and ongoing control on cleared areas or areas where seed rain is a continuing problem. While these tools are accepted practice on modified pasture lands, there are some off farm situations where serious consideration needs to be given to the use of an effective grazing regime as a tool. Two examples are cited:

- On PCL lands which have a significant wilding conifer issue and the cost of maintaining the secondary control is too high due to reinvasion or the proximity of major seed sources. As an example the PCL within and above the West Pukaki MU on the Ben Ohau Range is currently being reinvaded by seed from this major seed source. On some of this land the P. contorta has already reached coning age and many of the trees are beyond being controlled by grazing. However, before an effort is made to remove these trees a strategic and cost effective secondary control regime which includes grazing needs to be considered.
- Another example is in the aftermath of a control operation like the LINZ clear-felling along the lakeshore of Lake Pukaki. This operation has left behind a visually degraded landscape with ongoing control issues of the secondary growth. Controlling secondary growth is an unpredictable cost and consideration should again be given to the use of grazing as a tool as part of the post control management in these situations. Once forest has established at dense levels any natural vegetation and values will have often been obliterated. Fencing and grazing such areas with the appropriate regime will provide cost effective secondary management and in many cases make the landscape more attractive.

8.7 Strategic objective 7: Awareness, education and social change

Undertake awareness, education and social change to ensure the strategy is supported and successful.

8.7.1 Commission the preparation of a comprehensive communications plan

The best way to manage these outcomes for this strategy would be to commission a professional "communications plan". This plan will cover all aspects of promoting awareness, education, social marketing and media management. The level of support for this strategy shown in the initial landholder discussions is a good platform on which to build this advocacy. The plan should be aligned with any future "national communications plan".

8.7.2 Establish ongoing liaison with landholders

There is a clear need to continue to communicate the strategy and its evolution, the annual planning and reporting on the control operations to landholders. They are currently a key part of why much of the MWCM Zone is still relatively clear of wilding spread. Therefore, they need to be kept informed and be part of the ongoing solution. A number of the landholders spoken with were happy to continue funding their own programme and see any additional funding go towards the control of major seed sources and spread that was clearly beyond the capacity of individual landholders. There were other landholders who held the counter view as well that those who had languished should not be subsidised by others who had continued to undertake effective control programmes at their own cost.

There are numerous ways in which this liaison could be done (email, newsletter, media, and website) and there are established internal organisation channels that could be utilised such as Federated Farmers.

8.7.3 Establish liaison with iwi

Engaging in korero with iwi with regard to their concerns about the issue of wilding conifer spread and management is another vital part of taking this strategic approach forward. The 3 local runaka have a strong relationship with the area known to them as Te Manahuna (Greenaway et al., 2015).

8.7.4 Provide up to date toolbox and conifer identification information to landholders

There are information and training needs that need to be provided to landholders and others actively engaged in wilding conifer control. Ongoing training and information about new methods and tools should be made available so that new techniques like basal bark are applied correctly and can be used successfully. In collecting information from landholders I heard from several of them that their efforts with using some of these new techniques had not proven to be 100 per cent successful. Another useful tool for landholders would be a conifer identification tool. One of the issues faced in preparing this strategy was that many landholders were not sure about the identity of the conifers they had on their property. In order to meet the objective of eventual zero density of P.

contorta in the MWCM Zone then the more eyes on the lookout for it and being able to identify it and other conifers by species the better.

8.7.5 Provide information to the wider public on wilding conifer management

There are a range of channels which could be utilised for sharing information with the public. Gathering further public understanding and support is vital to gaining both further Crown and community sourced funding. The mapping information can be shared with the public on the ECAN website mapping system.

Consideration needs to be given to a website, Facebook page and other traditional media. Even the old fashioned brochure may have a place. For instance, the Queenstown Lakes District Council have produced a short publication on wilding conifers which is available to the public and concisely presents the key information.

8.7.6 Engage with volunteers and volunteer organisations

There are people keen to volunteer for wilding control work. One group local to Twizel runs a regular programme of wilding control in areas close to Twizel. Other out of area groups have also undertaken work in the Mackenzie area.

A couple of Tekapo locals also engage in wilding control work on an ad hoc basis and it would be worth seeing if they wished to undertake their work in collaboration with the Trust.

While the task is enormous and volunteer contributions are likely to be small in the scale of the total effort, it is important that they are employed on work that will be meaningful and of value. More importantly for them they can see a result for their effort in the time they have available.

8.7.7 Engage on a regular basis with other operational projects

Sharing successes and learnings with others in the same game is vital for remaining at the "sharp end" of the game. The N.Z. Wilding Conifer Management Group www.**wildingconifers**.org.nz is one place where this information can be shared.
However, one of the best mechanisms for sharing skills, new methods and learnings are field days. Hosting or going to a field day/workshop on regular basis (suggest biannual) can be a reasonably cost effective way of getting others in the business together. As is the case with these sorts of events the conversations at the break times or in the evening is often where new ideas are born. Avoiding the replication of experiments, trials and mistakes which all cost money is one clear benefit of such exchanges.

8.8 Strategic objective 8: Regulatory options

Advocate and collaborate to achieve regulatory controls for wilding conifer management and forestry in the MWCM Zone.

8.8.1 Advocate for inclusion of wilding conifer controls and other enabling rules where appropriate in District and Regional Plans

The MWCM Zone comes under the jurisdiction of one regional council, the Canterbury Regional Council and three district councils. The majority of the area is under the Mackenzie District Council's jurisdiction but there are small areas in the southern part of the zone under both the Waitaki and Waimate District Councils[12].

This strategy is first and foremost based on collaboration. However, there needs to be a background of support in the regulatory environment. There are two levels of planning documents for influencing the wilding conifer management at a planning level. Firstly, at a regional government level, within the Canterbury Regional Pest Management Strategy and secondly at a district planning level, within the Mackenzie, Waitaki and Waimate District Plans.

These plans need to be enabling wherever possible to ensure post control and follow-up activities which are environmentally acceptable are not hindered by the planning framework.

8.8.1.1 District plans

Currently neither the Waitaki District Council (WDC) nor Mackenzie District Council (MDC) District Plans contains any policies which require the eradication of wilding conifers at either a property or landscape level. The Waimate District Plan contains a rule which means forest owners *et al* have responsibility to "eliminate tree spread and the growth of wilding trees emanating from a forest on all land within 500 metres of the forest edge".

Forestry plantings can be restricted in the Mackenzie District Plan if the council considers there is potential of "the spread and growth of wilding conifers emanating from the proposed forest".

The MDC Plan prevents the planting of P. contorta and P. sylvestris amongst other species. The WDC Plan prevents the establishment of both these species plus P. nigra, Douglas fir, and Larch in the Rural Scenic Zone which covers all the land administered by the Waitaki District inside the MWCM Zone. The Waimate District Plan contains a rule which prevents the planting of P. contorta, P. sylvestris, P. uncinata and P. mugo.

At a national level the forest industry along with Ministry for Environment are working on a National Environmental Standard under the RMA. This includes a section on wilding conifers and new plantings.

[12] See "Maps of the Mackenzie Wilding Conifer Management Strategy": Map 2.

Logically, the three District Plans would be better tools for the management of wilding conifers in the MWCM Zone if they were entirely consistent with respect to all of these rules related to wilding conifers.

8.8.1.2 Regional Pest Management Strategy (RPMS)

The current Canterbury RPMS is "light" on any regulatory controls on wilding spread. Work that is currently being done at both a national level on RPMS Wilding Rule development and for the Canterbury RPMS is likely to result in a considerable change in the nature of the "rules" around control of wilding spread for both private landholders and Crown agencies.

Both the Waitaki District Plan and RPMS are currently under review and there are or will be opportunities to advocate for the inclusion of supportive regulatory frameworks to support this strategy.

8.8.2 Utilise the provisions in the Crown Pastoral Land Act and Land Act 1948.

These two Acts contain provisions which can be utilised by LINZ for the management of wilding conifers on pastoral leases. Approximately two thirds of the land utilised for farming in the MWCM Zone is pastoral lease. This legislation provides an avenue for more formal action if required.

8.9 Strategic objective 9: Research

Promote the Mackenzie as a region for ongoing national research and support local research into wilding conifer management in a coordinated manner.

There has been considerable funds and time invested in research on wilding control over many years but in the last 10 years significant advances and cost savings have been made with new and refined techniques. Many of the recent research projects have been based in the Mackenzie area. Being at the cutting edge of these techniques has many advantages including being able to adopt these developments earlier than other regions. Continuing to seek and be involved in these sorts of projects continues to raise the profile of the Mackenzie and allows benefits from the research work which is often funded in a partnership arrangement without meeting the full cost of the control undertaken as part of the research.

8.9.1 Remote sensing as a research project

On this basis, the remote sensing discussed under Strategic Objective 2 is a project which has enormous potential to revolutionise the measuring, monitoring and reporting of wilding conifer management. At a national level this is a project which is currently under development. This may be an opportunity to utilise this national research at a local level by offering the MWCM Zone or part of it as a pilot project.

8.9.2 Spraying trials

Over the last few years there have been significant advances in the development of sprays for wilding conifers. Most notably, the development of X-Tree for the basal bark technique which has allowed significant increased efficiencies with ground and air control techniques.

Currently work is being undertaken to improve the efficiency of TDPA[7] by utilising new elements in the spray which is used for dense forest. If this works it could increase the effectiveness and reduce the cost of this spray type. It has the potential to reduce the cost by $500 / ha bringing the dense forest treatment cost down to $1700 / ha.

8.9.3 Burn trials at Pukaki Downs and Ferintosh

Grant Pearce of SCION has been setting up and establishing trials at Pukaki Downs and Ferintosh to test the efficacy of desiccation and burning to control wilding conifers (Scott, Pearce, & Clifford, 2015) (SCION Research, 2015) (*pers. comms*. G. Pearce). These trials are in their very early stages but if proven successful could provide a much cheaper means of control of dense wildings stands. This is another trial which is worth supporting and potentially sharing in the benefits of the research as well as being at the "sharp end" if it works.

The first stage of these trials on younger stands will be complete in 2-3 years and the second stage on intermediate and older trees in a further 3-5 years provided conditions are suitable.

8.9.4 Utilisation for post wood

Current investigations into the value of the trees within the West Pukaki MU are being undertaken to see if the trees have any potential value as post timber with a tanalising test being undertaken.

8.10 Strategic Objective 10: Alternative options for control and secondary follow-up

Explore the options for major seed source control in West Pukaki and Mount Cook Management Units.

8.10.1 Engage with all landholders in the West Pukaki MU to develop a separate and comprehensive Operational Plan for this MU

A seed bomb

Doing nothing in the long term in the West Pukaki MU is not a realistic option as already highlighted. The seed production from the existing large coning forest is massive – estimated at up to 18 billion seeds per annum and with a 5 per cent germination rate the potential for nearly 1 billion new seedlings per annum.

This MU is very close to being intractable and further delays in acting are only going to increase the cost at close to $100,000 per annum.

This MU is clearly a significant issue for which there is no straight forward answer and needs a process of collaboration and agreement around an operational plan. This plan could be expanded to the whole of Sub Zone 4. The issues highlighted under Section 8.2 (Strategic Objective 2: Funding) demonstrate that this will be the most expensive unit of control in the MWCM Zone. It has a number of significant risks:

- the sheer scale of the problem
- landholders with divergent views
- cost escalation
- funding limitations of landholders
- the ETS forests on Pukaki Downs
- seed rain to adjacent properties

Pukaki Downs Station has a significant area of forest in the ETS scheme (1251 ha). However, without an agreed long term plan the current efforts will not achieve a long term outcome and hence are not sustainable or ever going to be effective. In fact, it is clear that unless there is a significant boost in funding this unit will not be able to be dealt with utilising current methods and an economic solution needs to be explored and implemented that makes both the removal cost and the ongoing management cost sustainable.

Pukaki Downs, like Mount Cook Station is keen to exit the ETS scheme so that it can undertake removal of the wildings on its property without the limitations of having to replant the forest.

8.10.1.1 Undertake a "blue skies" think tank with wilding conifer professionals, landholders and others who can add value to look at options for this Management Unit/Sub Zone

This think tank would explore the concept of an economic solution for this unit. Without fettering the thinking, the types of things that need exploring are both removal and follow up methods:

- Wide use of discing.
- Burning of the standing trees.
- Machine removal and slash burning.
- Progressively establishing a deer farming operation after removal of the wilding conifers. Deer paddocks are very effective at eliminating wilding conifers. This may be one of the only ways to undertake this secondary control economically.
- Other options that might be suitable on the smaller units where landowners may wish to employ more environmentally friendly methods.

8.10.2 Formulate an operational plan for the Mount Cook MU in conjunction with the new owners at Mount Cook Station, LINZ, Department of Conservation, Ministry of Defence and Braemar Station

Mount Cook Station is at the heart of the other major seed source issue which is going to be difficult and expensive to solve. While this is a significant issue it is able to be contained much more easily than the West Pukaki MU due to the fact the coning conifers are mainly Larch and P. nigra (not P. contorta). Removing and eradicating the wilding conifers from the whole area of the station will still require a long term approach. The first step will be to clearly establish some containment lines to which Mt Cook Station and the neighbouring landholders can work while the main seed source is removed.

Due to the scale of the problem it needs a clear long term plan that is economic and achievable for the owners and surrounding landholders. Mount Cook Station has a significant area of forest in the ETS scheme (estimated at 1700 ha). The new owners are keen to exit this programme to give them the ability to control the seed source without the limitations of having to replant forest at the same scale (*pers. comms C. Miles*). There would be a clear advantage in the Trust and agencies supporting and advocating for this outcome with MPI given the implications for the whole MWCM Zone and Strategy.

Photo 10: Mount Cook Station and adjacent PCL: Photo: R.Young

9 Management Unit Tables: Cost data, Tree data, Descriptions and Proposed Management

The tables in this section summarise the data extracted from the database and other sources to inform this strategy and enable the prioritisation of the Management Units and Sub Zones within the MWCM Zone.

9.1 Cost Data

Table 14: Management Unit and Sub Zone Data

Mackenzie Wilding Conifer Management Units and Sub Zones Base Data and Costs									
Sub Zone	Management Unit	Priority within sub zone for removal	MU GOAL	Management Approach	Total Area of MU/SZ	Total Area affected by conifer spread	Percentage affected by conifer spread	Estimated cost of initial treatment of MU	Progressive Sum
1	Grays Hills	1	Environmental Economic Social	ERADICATION	38733	2478	6%	$ 135,825	$ 135,825
1	Central Mackenzie	2	Environmental Economic Social	ERADICATION	49178	10192	21%	$ 662,797	$ 798,622
1	Grampian	3	Environmental Economic Social	ERADICATION	56935	11013	19%	$ 426,718	$ 1,225,340
1	Braemar	4	Environmental Economic Social	ERADICATION	23174	17980	78%	$ 981,864	$ 2,207,204
1	Tekapo Town	5	Environmental Economic Social	PROGRESSIVE CONTAINMENT	950	210	22%	$ 43,863	$ 2,251,067
1	East Pukaki	6	Environmental Economic Social	PROGRESSIVE CONTAINMENT	5180	3102	60%	$ 2,742,397	$ 4,993,464
1	Burke	7	Environmental Economic Social	PROGRESSIVE CONTAINMENT	6457	1523	24%	$ 1,101,384	$ 6,094,848
1	Tekapo River	8	Environmental Economic Social	ERADICATION	4092	4092	100%	$ 102,305	$ 6,197,153
2	Benmore Range	1	Environmental Economic Social	ERADICATION	17548	4289	24%	$ 305,522	$ 6,502,675
2	Twizel Flats	2	Environmental Economic Social	ERADICATION	12008	970	8%	$ 319,981	$ 6,822,656
2	Twizel Town	3	Environmental Economic Social	PROGRESSIVE CONTAINMENT	910	48	5%	$ 23,436	$ 6,846,092
2	Pukaki River	4	Environmental Economic Social	ERADICATION	930	930	100%	$ 23,244	$ 6,869,336
3	Hall-Haszard	1	Environmental Economic Social	ERADICATION	48520	9602	20%	$ 545,369	$ 7,414,705
3	Two Thumbs	2	Environmental Economic Social	ERADICATION	44823	7113	16%	$ 120,925	$ 7,535,630
3	Burnett	3	Environmental Economic Social	ERADICATION	22254	7317	33%	$ 231,592	$ 7,767,222
3	Ben Ohau North	4	Environmental Economic Social	ERADICATION	22626	1040	5%	$ 22,740	$ 7,789,961
3	Motuariki	5	Environmental Economic Social	ERADICATION	17	17	99%	$ 8,618	$ 7,798,579
3	Mount Cook	6	Environmental Economic Social	SUSTAINED CONTROL	8167	5359	66%	$ 5,547,318	$ 13,345,897
3	Aoraki	7	Environmental Economic Social	EXCLUSION	106828	0	0%	$ 0	$ 13,345,897

Mackenzie Wilding Conifer Management Units and Sub Zones Base Data and Costs

Sub Zone	Management Unit	Priority within sub zone for removal	MU GOAL	Total Area of MU/SZ	Total Area affected by conifer spread	Percentage affected by conifer spread	Estimated cost of initial treatment of MU	Progressive Sum
4	Ben Ohau South	1	Environmental Economic Social	45878	28477	62%	$ 2,361,604	$ 15,707,501
4	Ohau River	2	Environmental Economic Social	4190	2400	57%	$ 1,328,467	$ 17,035,968
4	Manuka Terrace	3	Environmental Economic Social	1052	597	57%	$ 113,215	$ 17,149,184
4	West Pukaki	4	Environmental Economic Social	14855	10584	71%	$ 11,149,543	$ 28,298,727
TOTALS				535,306	129,332	24%	$ 28,298,727	

Sub Zone	Priority of Sub Zone	No of MU's					
Sub Zone	1	8	184701	50591	27%	$ 6,197,153	$ 6,197,153
Sub Zone	2	4	31396	6236	20%	$ 672,183	$ 6,869,336
Sub Zone	3	7	253235	30448	12%	$ 6,476,561	$ 13,345,897
Sub Zone	4	4	65974	42058	64%	$ 14,952,830	$ 28,298,727

9.2 Tree Data

Table 15: Tree Data

Mackenzie Wilding Conifer Management Units and Sub Zones Tree Data

Sub Zone	Management Unit	Priority within sub zone for removal funding	Management Approach	Initial management	% affected by conifer spread	Main Species	Other Species	Age	MU seed source rating	Dense Area	Moderate Area	Sparse Area	Scattered Outliers Area	Total Area	Estimated cost of initial treatment of MU
1	Grays Hills	1	ERADICATION	Remove Spread	6%	P con	P nig	Coning	Isolated	21	83	1456	919	2478	$ 135,825
1	Central Mackenzie	2	ERADICATION	Remove Spread	21%	P con	P syl	Coning	Moderate	63	308	6684	3138	10192	$ 662,797
1	Grampian Glenrock	3	ERADICATION	Remove Spread	19%	P nig	P con	Coning	Moderate	116	0	4169	6729	11013	$ 426,718
1	Braemar	4	ERADICATION	Remove Spread	78%	P nig	P con	Seedling	Moderate	13	516	16650	801	17980	$ 981,864
1	Tekapo Town	5	PROGRESSIVE CONTAINMENT	Remove Seed Source	22%	P con	P nig	Coning	Significant	0	66	132	11	210	$ 43,863
1	East Pukaki	6	PROGRESSIVE CONTAINMENT	Remove Seed Source	60%	P con	L dec	Coning	Major	989	1047	653	413	3102	$ 2,742,397
1	Burke	7	PROGRESSIVE CONTAINMENT	Remove Seed Source	24%	P con	P con	Coning	Major	473	78	597	375	1523	$ 1,101,384
1	Tekapo River	8	ERADICATION	Ongoing Landholder Management	100%	P con	P nig	Pre-coning	Low	0	0	4092	0	4092	$ 102,305

Mackenzie Wilding Conifer Management Units and Sub Zones Tree Data

Sub Zone	Management Unit	Priority within sub zone for removal funding	Management Approach	Initial management	% affected by conifer spread	Main Species	Other Species	Age	MU seed source rating	Dense Area	Moderate Area	Sparse Area	Scattered Outliers Area	Total Area	Estimated cost of initial treatment of MU
2	Benmore Range	1	ERADICATION	Remove Spread	24%	P con	P nig	Coning	Moderate	21	145	3196	927	4289	$ 305,522
2	Twizel Flats	2	ERADICATION	Remove Spread	8%	P con	P syl	Coning	Low	0	631	16	322	970	$ 319,981
2	Twizel Town	3	PROGRESSIVE CONTAINMENT	Remove Seed Source	5%	P con	P syl	Coning	Significant	0	47	0	1	48	$ 23,436
2	Pukaki River	4	ERADICATION	Ongoing Landholder Management	100%	P con	P nig	Pre-coning	Low	0	0	930	0	930	$ 23,244
3	Hall-Haszard	1	ERADICATION	Remove Spread	20%	P con	P nig	Coning	Moderate	193	52	95	9263	9602	$ 545,369
3	Two Thumbs	2	ERADICATION	Remove Spread	16%	P nig	P con	Coning	Isolated	5	126	13	6968	7113	$ 120,925
3	Burnett	3	ERADICATION	Remove Spread	33%	P nig	L dec	Pre-coning	Isolated	45	2	2171	5097	7317	$ 231,592
3	Ben Ohau North	4	ERADICATION	Remove Spread	5%	L dec	P syl	Pre-coning	Low	0	30	102	908	1040	$ 22,740
3	Motuariki	5	ERADICATION	Remove Seed Source	99%	P con	P nig	Coning	Moderate	0	17	0	0	17	$ 8,618
3	Mount Cook	6	SUSTAINED CONTROL	Containment	66%	P nig	L dec	Coning	Major	2196	1333	1406	425	5359	$ 5,547,318

Mackenzie Wilding Conifer Management Units and Sub Zones Tree Data

Sub Zone	Management Unit	Priority within sub zone for removal funding	Management Approach	Initial management	% affected by conifer spread	Main Species	Other Species	Age	MU seed source rating	Dense Area	Moderate Area	Sparse Area	Scattered Outliers Area	Total Area	Estimated cost of initial treatment of MU
3	Aoraki	7	EXCLUSION	Ongoing Landholder Management	0%				Isolated	0	0	0	0	0	$ 0
4	Ben Ohau South	1	ERADICATION	Remove Spread	62%	P con	L dec	Pre-coning	Moderate	110	2132	21364	4872	28477	$ 2,361,604
4	Ohau River	2	PROGRESSIVE CONTAINMENT	Containment	57%	P con	L dec	Coning	Major	234	1530	507	129	2400	$ 1,328,467
4	Manuka Terrace	3	PROGRESSIVE CONTAINMENT	Containment	57%	P nig	P con	Coning	Significant	0	202	234	161	597	$ 113,215
4	West Pukaki	4	PROGRESSIVE CONTAINMENT	Containment	71%	P con	P nig	Coning	Major	4268	3226	3090	0	10584	$ 11,149,543
TOTALS					24%					8,747	11,571	67,555	41,459	129332	$ 28,298,727

Sub Zone	Priority of Sub Zone	No of MU's									
Sub Zone	1	8	27%	1675	2099	34432	12385	50591	$ 6,197,153
Sub Zone	2	4	20%	21	823	4141	1250	6236	$ 672,183
Sub Zone	3	7	12%	2439	1559	3788	22662	30448	$ 6,476,561
Sub Zone	4	4	64%	4612	7090	25194	5162	42058	$ 14,952,830

9.3 Descriptions and Values

Table 16: Descriptions and Values

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values											
Sub Zone	Management Unit	within sub zone for removal	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
1	Grays Hills	1	This large MU stretches from the Tekapo Township to Lake Benmore and takes in all the land on the western side of Haldon Road and the flats to the east. It is relatively free of significant spread with just 7 percent of the area affected. However it does have several roadside shelterbelts / plantings containing P.Contorta within its boundary. The Haldon Camp also contains mature seeding P. contorta and other mature coning conifers. Includes the Lake Tekapo Scientific Reserve.	Grassland farming.	5	Landscape. Botanical. Invertebrates. Native Fish. Trout. Wetlands. SONS, SSWI and RAPs. Lake Tekapo Scientific Reserve (LTSR).	Acutely threatened. Chronically threatened. At risk. Critically underprotected.	18	1	1009	3%
1	Central Mackenzie	2	This large MU stretches from the Braemar Road to the junction of the Pukaki and Tekapo Rivers (excluding the East Pukaki MU). It is relatively free of significant spread with just 9 percent of the area affected.	Grassland farming. Cropping. Plantation forests.	5	Landscape. Ecological. Botanical. Fauna. Aquatic. Insects. Invertebrates. Wetlands. Native fish. SONS and RAPs.	Acutely threatened. Chronically threatened. At risk. Critically underprotected.	18	1	410	1%
1	Grampian Glenrock	3	This large MU (#2 in size)stretches from SH8 at Burkes Pass to Lake Benmore and takes in all hill country on the eastern side of Haldon Road. With 19 percent of the area affected by sparse and scattered outlier spread it is still needing considerable effort to get it into a surveillance and control regime. The MU is also threatened by outlier spread on the eastern side of the range which is outside the strategy area.	Grassland farming. Tussock grasslands.	3	Landscape. Ecological. Botanical. Invertebrates. Fauna. Native Fish. Trout. Wetlands. SONS and RAPs.	Acutely threatened. Chronically threatened. At risk. Critically underprotected.	18	5	23	0%
1	Braemar	4	This MU includes most of the TMTA, Braemar and Balmoral stations. It is now almost clear of coning trees , there is just 700+ha of coning spread left in this MU (3-4 percent). There are still mature VHS risk coning trees at the Maryburn Hut site.	Grassland farming.Tall tussock grassland. Defence training area.	5	Landscape. Ecological. Botanical. Fauna. Wetlands. SONS and RAPs. Native fish. Trout. Recreational.	Chronically threatened. At risk. Critically underprotected.	12	2	2970	13%

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values

Sub Zone	Management Unit	Priority within sub zone for removal funding	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
1	Tekapo Town	5	The plantations and Regional Park around Tekapo contain species such as P. contorta, Larch and D. fir. The plantations are the responsibility of the MDC and ECAN. The very high spread vigour coning trees continue to be a seed source for surrounding MUs including areas like the Tekapo Scientific Reserve and the Tekapo River.	Grassland farmland on surrounding MUs.	0	None.	Chronically threatened. At risk	9		260	27%
1	East Pukaki	6	A mixture of dense to sparse spread with some outliers. This is a major seed source for the Central Mackenzie MU. It is rapidly increasing in size and density and becoming an out of control seed source. Over 3000ha (60%) of this MU is affected by spread. The eastern shoreline of Lake Pukaki (under LINZ management) is included in this MU.	Grassland farming.	3	Landscape. Botanical. Invertebrate. Dryland scrub RAP Mt Mary. Recreational access.	Critically Underprotected At Risk	7		0	0%
1	Burke	7	A mixture of dense to sparse spread with some outliers. This is becoming a major seed source for the Burke and surrounding MUs. It is rapidly increasing in size and density and becoming an out of control seed source. Over 1500ha (24%) of this MU is affected by spread. There are two significant outlier seed sources outside the strategy boundary in the Opuha and Opihi catchments which are potential seed sources that will need to be managed in conjunction with this MU.	Grassland farming.	3	Landscape. Botanical. Fauna. Ecological. Native Fish.	Critically Underprotected At Risk	7		30	0%
1	Tekapo River	8	Tekapo River. Braided River system which has had the legacy conifer plantings removed. Lands managed by LINZ.	Not applicable.	0	Recreational. Botanical. Braided river system. Tekapo River RAP, SSWI and SONS. Native fish and long finned eel. Trout.	At risk. Critically underprotected.	7		0	0%

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values

Sub Zone	Management Unit	Priority within sub zone for removal funding	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
2	**Benmore Range**	1	Includes part of the Benmore Range, Glenbrook flats and the Ohau River. There are some significant areas of sparse density pre coning spread and outliers affecting about 25 per cent of the MU. There is an outlier seed source on the area to the south of this MU on Peak Valley.	Grassland farming. Tussock grasslands.	5	Landscape. Ecological. Botanical. Fauna - native fish. Ohau River and Lake Benmore RAPs and SONS. Benmore CA.	Acutely Threatened. At Risk. Critically underprotected. Underprotected.	15	5	1536	9%
2	**Twizel Flats**	2	Area lying between the Pukaki Canal and the Ohau and Pukaki Rivers but not including the Twizel Town area. Only a small percentage of this area is affected now after the spread to the west of the Twizel River was removed in recent times. There are only some small infestations of coning trees.	Grassland farming. Cropping.	5	Landscape. Ecological. Pukaki Flats CA. SONS and RAPs - Ohau, Pukaki and Fraser Rivers. Kaki aviaries and Ruataniwha Wetlands. Native fish. Trout.	Chronically threated. At Risk. Critically Underprotected	12	3	1775	15%
2	**Twizel Town**	3	An area of wilding conifers to the south of the town plantation. Both the wilding block and the plantations contain species such as P. contorta, P. sylvestris, Larch and D. fir. The plantations are largely the responsibility of the MDC. These coning trees continue to be a seed source for surrounding MUs and this has been cited as an issue by downwind landowners.	Grassland farmland on surrounding MUs.	0	None.	Chronically threated. At Risk. Critically Underprotected	12		75	8%
2	**Pukaki River**	4	Pukaki River. Braided River system which has had the legacy conifer plantings removed. Lands managed by LINZ.	Not applicable.	0	Recreational. Botanical. Braided river system. Pukaki River RAP and SONS. WERI. Native fish.	Critically underprotected.	3		0	0%

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values

Sub Zone	Management Unit	Priority within sub zone for removal funding	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
3	Hall-Haszard	1	The third largest MU. A mixture of mainly widespread scattered outlier spread with some isolated dense to sparse areas of spread. Both Very High and High spread species are present. Over 9,000ha (16%) of this MU is affected by spread. The hut sites at Rankin and Manning Stream still have small areas of coning mature conifers which are recorded as plantations.	Grassland farming. Tussock grasslands.	3	Recreational. Landscape. Botanical. Inverterbrate. Fauna. Ecological. Native fish. SONS, SSWI and RAPs in the Godley and Cass Rivers. PCL and borders on AMC National Park.	Chronically threatened. At risk. Critically underprotected.	12	4	9847	20%
3	Two Thumbs	2	This is the fifth largest MU. It has a relatively small percentage of the area affected by spread and a few plantation seed sources but they are all at the lakeside. A large percentage of the MU is PCL in the Te Kahui Kaupeka CP.	Grassland farming. Tussock grasslands. Economic value of the parks.	5	Landscape. Botanical. Ecological. Fauna. Kaki habitat. Native fish. Wetlands. Trout. Te Kahui Kaupeka CP.	Chronically threatened. At risk	7		15958	36%
3	Burnett	3	This MU is bordered by Mt Cook Station, AMCNP, Glenmore Station and the TMTA. There is a large area of preconing scattered outlier spread, (>5000ha) within the Jollie catchment which is seeded from the MtCook MU. Virtually the whole unit is PCL.	Economic value of the parks.	0	Landscape. Recreational. Ecological. Native fish. RAP - Landslip Ck.	Critically underprotected.	3		28786	129%
3	Ben Ohau North	4	This MU is one of the "cleanest" in the strategy region.The eastern side of the MU has less than 1000has affected by spread or 4% of the total area. The absence of P contorta is notable. The upper regions of the Dobson are also clean.	Grassland farming.	3	Landscape. Ecological. Significant area of PCL and Ruataniwha CP. Tasman and Dobson Rivers (SSWI). Bush Stream SSWI. Tasman Wildlife refuge. Native fish. Trout.	Critically underprotected.	3		11727	52%
3	Motuariki	5	Motuariki Island is a small but potentially significant seed source with P contorta and P nigra present.	None.	0	SONS and RAP - Lake Tekapo. Botanical. Recreational.	No threatened categories	0		17	100%

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values

Sub Zone	Management Unit	Priority within sub zone for removal funding	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
3	Mount Cook	6	A mixture of dense to sparse spread with some outliers. This is a major seed source for the Braemar MU and the Burnett-Gamack MU. While partly contained it will remain a significant seed source for P Nigra and Larch. Over 5300ha (66%) of this MU is affected by spread. Part of this forest is registered as an ETS forest.	Grassland farming. Plantation forests.	3	Landscape. Recreational. Botanical. Fauna. SONS and RAPs - Tasman River and Landslip Ck. Wetlands. Native fish.	At risk	4		9250	4%
3	Aoraki	7	The majority of this area is contained in Aoraki Mount Cook NP and Te Kahui Kaupeka CP. There are no conifers in the National Park. A significant proportion of the area is over 1800m altitude so not prone to conifer invasion. Occasional wilding conifer found in this area.	Economic value of the parks.	0	National Park and Te Kahui Kaupeka CP. World Heritage Area. Botanical. Ecological. Recreational. Fauna. Landscapes.	No threatened categories	0		105783	49%
4	Ben Ohau South	1	A mixture of widespread moderate to sparse spread with areas of scattered outliers but mostly preconing. There are also some small but significant dense bomb clusters in the southern sector. Over 28,000ha (62%) of this MU is affected by spread. There are two significant D fir plantations which will need continued wilding surveillance and control. A significant part of this MU is PCL.	Grassland farmland. Plantation forests.	3	Landscape. Ecological. Significant area of PCL. Irishmans and Pyramid RAPs - outside PCL areas.	At risk. Critically under protected. Under protected.	9		21575	10%
4	Ohau River	2	A mixture of dense to sparse spread with some outliers. This is becoming a major seed source for the Ohau MU and surrounding MUs. It is rapidly increasing in size and density and becoming an out of control seed source. Over 2500ha (59%) of this MU is affected by spread.	Grassland farming. Plantation forests.	3	Fauna - native fish, eels and trout. Ohau River RAP and SONS 10+11. Recreational access.	Critically Under protected At Risk	7		75	0%

Mackenzie Wilding Conifer Management Units Descriptions, Productive and Natural Values

Sub Zone	Management Unit	Priority within sub zone for removal funding	Description	Productive values at Risk	Productive values score	Natural Values at Risk within MU	LENZ Threat Category	LENZ score	Susan Walker Rating	Area of PCL	% PCL Area
4	Manuka Terrace	3	A lifestyle block subdivision with 190 blocks which has significant stands of moderately dense coning P. contorta, P. sylvestris and P. nigra on about 22 per cent of the land.	None.	0	Halls totara and manuka RAPs run along the back edge of Manuka Terrace. Loss of open landscapes of the terrace area.	At risk	4		4	0%
4	West Pukaki	4	Closed canopy forest and moderate density spread over a significant part of this MU. This area is the most significant seed source in the MWCM zone. Several landholders with a range of views on how to manage the wilding conifer spread and main stand. LINZ and DOC managed lands are within and adjacent to this MU.	Grassland farming. Lavender farm. Cropping land.	3	Ecological. Fauna - kaki, native fish. Flora - Hebe cupressoides, bog pine. Wetlands. Lake Pukaki ScR. Lake Poaka SR. Ruatanihwha Conservation Park. Recreational- access to Ben Ohaus, Dusky trail.	Critically Underprotected. At Risk	7		4674	31%
TOTALS								194	21	215786	40%

Sub Zone	Priority of Sub Zone	No of MU's					
Sub Zone	1	8	24	96	9	4702	3%
Sub Zone	2	4	10	42	8	3386	11%
Sub Zone	3	7	14	29	4	181370	72%
Sub Zone	4	4	9	27	0	26328	40%

9.4 Proposed Management

Table 17: Management Units and Proposed Management

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
1	Grays Hills	1	Ongoing control efforts by landholders and DOC at the LTSR. As a result the spread is of seedling and pre coning age and is under regular surveillance. However there are several scattered outliers which contain trees note in the 2013 survey. There is also the coning P contorta at Haldon Camp and in the roadside shelterbelts which remains as a threat.	Check and remove all scattered outlier spread. Remove the remaining P contorta and other HS risk trees from the Haldon Camp shelterbelts. Remove the P contorta from roadside shelterbelts. Landowners continue ongoing annual programmes.	Once the outliers and the other P. contorta is removed there will be litle risk of reinvasion by P.contorta other than at the northern end from the Tekapo Township or the Burke MU's.	Maintain regular surveillance and control for seedling and pre coning conifers.	Very high	Low
1	Central Mackenzie	2	Most landholders have in place annual control programmes. The effectiveness is shown by the scale of the MU which is affected.	Landholders to continue their current ongoing management. Encourage reluctant landholders to undertake an ongoing programme of control.	Reinvasion of northern part of area from the East Pukaki MU. Risk of continued seedlings from coning trees which have been removed on this MU for several years to come. Landholders who are not active now failing to undertake control of existing spread.	Maintain regular surveillance and control for seedling and pre coning conifers. Grazing pressure to control young seedlings.	Very high	Low
1	Grampian Glenrock	3	Work undertaken by ECAN and DOC in this MU over the last few years in collaboration with landholders has made significant inroads into the wilding problem. Landholders generally have an ongoing annual programme.	Continue the partially funded ECAN control programme until all the coning trees are removed (including the Stony River mature coning stand) and the spread control is reduced to a surveillance and control programme. Assess the vulnerability of the northern part of this MU to reinvasion from the outlier areas to the east of the Dalgety Range.	Bomb cluster establishment fom felling coning P contorta.	Maintain regular surveillance and control for seedling and pre coning conifers.	Very high	Low

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
1	Braemar	4	The whole MU is under treatment by the Army, and landholders. Progressively the seed spread from the MT Cook MU has been contained on this MU and while this is not complete good progress has been made.	The coning trees at Maryburn Hut should be removed along with all the scattered outlier coning trees which cover about 700ha within this MU. Remove the P sylvestris from the roadside shelterbelt on Braemar Road. This potentially can be done under $5000. Continue rotational followup and keep remove trees as seedlings or preconers.	Reinvasion of area from the Mt Cook MU. Risk of continued seedlings from coning trees which have been removed on this MU for several years to come.	Maintain regular surveillance and control for seedling and pre coning conifers.	Very high	Very high
1	Tekapo Town	5	Removal of some of the P Contorta from both the MDC plantations and the Park has taken place in the past but it has not been complete removal.	Removal of all P.contorta and P. sylvestris from the plantations. Consider the removal of high spread vigour conifers like D.fir especially from outer edges of plantations.	Residents may be concerned at loss of trees within the Regional Park.	Seedling surveliance and removal every year for 10+ years.	High	Low
1	East Pukaki	6	There has been some control undertaken in the northern sector of this MU by Irishman Creek station and and significant effort in the southern parts by Maryburn station.	It is currently highly feasible to control this MU over a period of 1-3 years. This is one of three major seed source MUs which could be eliminated but at a reasonably significant cost ($2.7M). Reduction to zero density over the whole block is entirely feasible. Included in this control would be removal of all P. contorta and P. sylvestris from the LINZ lakeshore area.		Rotational follow up will be required. Mob stocking to control seedling regrowth will be essential.	Very high	Low

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
1	Burke	7	There has been some control undertaken on this area utilising ECAN and landholder funds. However it is still a significant risk as it is not contained and contains over 900has of coning P. contorta in 3 separate areas within the one catchment.	It is currently highly feasible to control this MU over a period of 1-3 years. This is one of three major seed source MUs which could be eliminated but at a reasonably significant cost ($1.4M). Reduction to zero density over the whole block is entirely feasible. Assessment of the risk of the outlier seed sources for reinvasion and their removal needs to be considered at the same time.	Bomb cluster establishment fom felling P contorta.	Rotational follow up will be required at 4 yearly intervals. Stocking to control seedling regrowth would be a desirable tool as part of the followup.	Very high	Low
1	Tekapo River	8	The removal of the legacy plantings in the last few years means that this area is now on regular surveillance and control for seedling and pre coning conifers.	Maintain regular surveillance and control for seedling and pre coning conifers.	Some risk of re invasion in the upper river from seed sources around Tekapo Town MU. Otherwise risk is low.	Maintain regular surveillance and control for seedling and pre coning conifers.	Low	Low
2	Benmore Range	1	Ongoing control for 10 years. P. mugo legacy plantings were removed several years ago. There has been continued surveillance and control on the PCL. Freehold and Uniiversity lease areas on the Benmore Range have had some treatment but there are still some significant areas of sparse density pre coning spread and outliers. Lake shore stands and plantations still contain seeding D.fir, P. sylvestris and larch. Currently the seed source MUs of West Pukaki and Ohau are the probable source of the P contorta.	Remove all coning and pre coning trees on the Benmore Range immediately. Undertake selective removal of the coning P. sylvestris around the lake edge. Consider removal of lakeshore larcha nd D.dir.	There is a continuing risk of invasion from the seed sources of West Pukaki and Ohau MU's.	Ongoing annual surveillance and control of seedlings and preconers. Grazing of the hill country on the 4 farm properties.	Very high	Low

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
2	Twizel Flats	2	Management of this unit and the low percentage invaded by spread (7%) is the result of land use practices and ongoing control by landowners and managers.	Removal of the outliers (coning?) from the Bendrose flats and the seedlings from Pukaki Flats Conservation Area would reduce the areas of spread to virtually nil. This followed by ongoing annual surveillance and control of seedlings and preconers.	There is a continuing risk of invasion from the seed sources of West Pukaki and the Twizel Town MU. The Twizel Town MU management actions need to be undertaken at the same time to reduce the threat of reinvasion from this source.	Ongoing annual surveillance and control of seedlings and preconers.	Very high	Low
2	Twizel Town	3	There has been considerable advocacy with the NW Arch lifestyle owners in the past mainly in relation to tree management for fire risk reduction. This has involved the removal of P. contorta both coning and seedling trees.	Continued advocacy with landowners and ensure the removal of all P.contorta and P. sylvestris from the plantations. Remove the wilding trees in the private land to the south of town.	Landowners will have differing opinions on the value of the trees. Getting a coordinated response from this many landholders will be difficult and time consuming but the previous work will have laid a good foundation.	Followup in and around the township should be simple with many landowners and small blocks. Council needs to have a programme of rotational followup control once the plantation trees are removed.	High	Low
2	Pukaki River	4	The removal of the legacy plantings in the last few years means that this area is now on regular surveillance and control for seedling and pre coning conifers.	Maintain regular surveillance and control for seedling and pre coning conifers.	Some risk of re invasion in the upper river from seed sources around Pukaki Dam and from the West Pukaki MU.	Maintain regular surveillance and control for seedling and pre coning conifers.	Low	Low
3	Hall-Haszard	1	Ongoing control efforts by landholders and DOC. Currently the fact that all of this spread is of pre coning or coning age is of concern given the apparent clean nature of 84% of this MU.	Undertake to complete removal of all trees from this MU in the next 12 months. Negotiate the removal of the coning mature trees at the 2 hut site sin the Godley.	Risk of reinvasion at sites with coning trees within the MU for next 10-15 years. Little risk of reinvasion from surrounding MU's.	Maintain regular surveillance and control for seedling and pre coning conifers.	Very high	Low

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
3	Two Thumbs	2	Ongoing control efforts by landholders and DOC. Most of this spread is of pre coning age and is under regular surveillance. The presence of isolated coning trees in a four areas is of concern and these should be removed ASAP.	Remove the 4 isolated coning areas. DOC to maintain regular aerial surveillance and control for seedling and pre coning conifers in the PCL. Landholders to continue current level of management.	Some risk of re invasion from the Burke MU and outliers in the Opihi and Opuha in easterly conditions and Tekapo Twn MU in southerly conditions. There are some plantation seed sources within the MU which need to be checked for HSV trees. Motuariki Island is also a potential seed source.	Maintain a regular cycle of aerial and ground surveillance for control of seedlings and pre coners.	Very high	Low
3	Burnett	3	Ongoing regular control efforts by DOC in this MU and on the bordering pieces of TMTA. Last control was undertaken in 2014.	Maintain regular aerial surveillance and control for seedling and pre coning conifers.	Reinvasion of area from the Mt Cook MU.	Maintain regular aerial surveillance and control for seedling and pre coning conifers.	Very high	Low
3	Ben Ohau North	4	The management of this unit with progressive removal of seed source, annual ongoing control and grazing shows the value of this approach. While there is no P. contorta the presence of P sylvestris is potentially just as big a threat. This unit is surrounded by the 2 large seed source MUs of Mount Cook and West Pukaki but upwind of both.	Removal of the last stand of coning conifers in Twin Stream along with the removal of the scattered outliers will mean that there is no potential seed sources in this MU. Ongoing annual surveillance and control of seedlings and preconers.	There is a continuing risk of invasion from the seed sources of West Pukaki and Mt Cook MU's.	Ongoing annual surveillance and control of seedlings and preconers.	Very high	Low
3	Motuariki	5	No management to date.	Remove all the P contorta and consider the felling of any high spread risk conifers - P Nigra, and if present D. fir, P. sylvestris.	Bomb cluster establishment fom felling P contorta.	Maintain regular surveillance and control for seedling and pre coning conifers.	Low	Very high

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
3	Mount Cook	6	DOC has undertaken control in the northern and southern sectors in the last 5 years. With removal of the larch stand at Rock Edam and removal and containment down towards the Coxes Downs boundary. MCS has undertaken a limited amount of work over the last 5 years.	This is the next most complex unit in the Mackenzie. It also requires a separate operational plan agreed between DOC, Mt Cook Station and the affected parties in the Braemar MU. With a cost in excess of $4M an economic solution for this MU is possibly the only way it will be contained and then managed. In the interim efforts need to focus on containment to existing moderate and dense canopy stands and controlling sparse and outlier spread to prevent establishment of more seed source. The positive feature of this seed source is that it does not contain contorta.	Reinvasion from this major seed source.	In the interim continued containment of the spread beyond the dense and moderate stands.	Low	Low
3	Aoraki	7	Ongoing surveillance as part of other park operations by DOC staff, reports from concessionaires and local pilots.	Ongoing surveillance as part of other park operations by DOC staff, reports from concessionaires and local pilots.	Potential for invasion from the Mt Cook and West Pukaki MU in a southerly quarter wind and isolated trees in the Godley Valley.	Ongoing surveillance as part of other park operations by DOC staff, reports from concessionaires and local pilots.	Low	Low

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
4	Ben Ohau South	1	Ongoing control for 15-20 years. Significant effort has gone into the legacy plantings in Stoney and Irishman in the past and surveillance and control on the PCL. Currently the massive seed source in West Pukaki is resulting in considerable invasion of all the eastern slopes of this MU.	This management unit is a high priority for intervention before the current crop of pre coning spread (26,599 has or 93% of the spread affected area) reaches coning age. Currently only 244 ha is coning and it is all at lower elevation sites. A significant proportion of the spread is on PCL. The containment line needs to be established around the western boundary of the West Pukaki MU.	Continued reinvasion from West Pukaki MU.	Continued rotations of control prior to coning age. Grazing should be considered as an option on the PCL for this MU as the seed source at West Pukaki continues to grow and increase the vulnerability of this area to invasion.	Very high	Low
4	Ohau River	2	This MU has lacked any significant control until recently when parts of the northern sector have been cultivated resulting in the removal of significant area of wildings. Over the last few years no control has been undertaken on the Glenbrook block and spread now extends 5-6 km from the Ohau River planted stand that is part of the seed source. There are several species of wildings including P.Contorta, P. Sylvestris, P. nigra and Larch	It is currently highly feasible to control this MU over a period of 1-3 years. This is one of three major seed source MUs which could be eliminated but at a reasonably significant cost ($1.4M). Reduction to zero density over the whole block is entirely feasible.Removal of the adjacent wilding seed sources on Manuka Terrace.	Reinvasion from adjacent seed sources including P. nigra and D.fir plantations.	Rotational follow up will be required at 4 yearly intervals. Stocking to control seedling regrowth will be essential.	Low	Very high
4	Manuka Terrace	3	Currently while some landowners may be doing control it is ineffective in managing the problem. This block will become a significant seed source for the surrounding MUs without a coordinated effort to manage the spread. These landholders have not been approached as part of this strategy development.	A separate programme needs to set up to undertake the control and management of this area of wilding spread. This programme will need agency leadership to be successful.	Landowners will have differing opinions on the value of the trees. Getting a coordinated response from this many landholders will be difficult and time consuming.	Following initial control followup will be reasonably simple if 100 per cent buy in is obtained with the many landowners. Small blocks make it a reasonably simple ongoing seedling pulling exercise.	Moderate	Very high

Mackenzie Wilding Conifer Management Units Proposed Management

Sub Zone	Management Unit	Priority within sub zone for removal funding	Current Management within MU	Proposed Management	Risks of control	Potential Follow-up	Priority for complete removal	Priority for containment
4	West Pukaki	4	Significant past effort by 3 large properties to contain the tree spread and control it. Both Crown agencies have invested significant effort in this MU too. Despite this the scale of spread has continued to grow. The smaller property owners have tended to undertake control in around dwelling sites and access. Pukaki Downs has a management plan prepared by Nick Ledgard. Currently 1200has is contained in an ETS forest.Recent development of 600has with cultivation is one highly successful technique for this level of infestation. Nearly 5000has has never had any significant treatment which has resulted in the development of a mature contorta (with some nigra) forest and the most significant seed source in the MCMS zone.	This is the most complex unit in the Mackenzie. It requires a separate operational plan agreed amongst all the landholders. With a cost in excess of $11M an economic solution for this MU is possibly the only way it will be contained and then eliminated. Initial efforts by the landholders need to focus on containment to existing moderate and dense canopy stand and controlling sparse spread to prevent establishment of more seed source.	Numerous land owners with differing views on control methods. Contains an area of ETS forest which means that the P contorta can only be removed by replacement with another species (potentially increasing the period of control) or refunding the carbon credit.	The scale of this issue means that if this wilding forest is removed then there will also need to be some economic followup techniques. Standard options like mob stocking will assist however given the scale and density of the wildings cultivation on a large scale with cropping or heavy grazing or conversion to deer farming are options that need to be considered. On PCL mob stocking needs to be utilised as one method of followup.	Low	Very high

10 Appendices

Appendix 1: List of Landholders and Agency Representatives Consulted

List of Landholders Consulted	
Property/Station	**Owners or Manager Consulted (in alpha order)**
Glencairn	Ben and Clare Aubrey
Ben Ohau Forest	Roger Belton
Mt Cook Station	Ross and Patience Bisset (and new owner Clint Miles)
Coxes Downs	Ross and Patience Bisset (and new owner Clint Miles)
Haldon	Paddy Boyd
Mt Gerald	Michael Burtscher
Lilybank	Michael Burtscher, Niksha Farac
Ben Ohau	Simon and Priscilla Cameron
Tekapo Regional Park	Murray Cox
Adagio Trust	Ingemar Dierickx
Simons Hill	Denis Fastier
Pukaki Downs	Ethan Gabriel, Rupert Price, Blake Foster, Allan Tibby, George Ormond
Irishman Creek	Evan Gibson
Godley Peaks	Rob Glover
Tasman Downs	Ian Hayman
Mt Cook Aoraki Farm	Charlie and Mary Hobbs
Ruataniwha Farm	Frank Hocken
Hurst Block	Matthew Hurst
Black Forest	Ben Innes
Glentanner	Ross and Helen Ivey
Katherine Fields	Ross and Helen Ivey
Orchard Estate Ohau River	Stephen Kincaid
The Grampians	Guy King
Omahau Hill	Mike Lindsay
Meridian	Paul Lloyd
Sawdon	Gavin and Susan Loxton
Streamlands/Curraghmore	Anne Mackay
Braemar	Hamish and Julia Mackenzie
Guide Hill	David and Marion Gould
Bendrose	Andrew McCulloch
Rhoboro	Doug McIntyre
Orchard Estate Point	Doug McIntyre
Glenbrook Dairy	Doug McIntyre
Ohau River	Doug McIntyre
Totara Peaks	Jim Metherill
Glenmore	Will Murray
The Wolds	John Murray
Maryburn	Martin Murray

Omahau Downs	Neil Lyons
Mt Cook Lakeside Retreat	Luke and Kaye Paardekooper
Glenrock/Holbrook	Ed Pawsey
Tekapo Airport	Richard and Tim Rayward
Richmond Station	Oskar and Karoline Reider
Ferintosh	Gill and Marion Seymour
Mt Hay	John Simpson
Balmoral	Andrew Simpson
Genesis	Colin Stevens
Grays Hills	Mark Urquhart
Simons Pass	Tony Walls
Aoraki Downs	Ken, Jane and Johnny Wigley
Glen Lyon	Ken, Jane and Johnny Wigley
Glenbrook (Simon)	Simon Williamson
Glenbrook (Henry)	Henry Williamson

List of Agency Representatives Consulted	
Agency	**Representative or Manager Consulted**
DOC	Peter Willemse and Keith Briden
ECAN	Graham Sullivan and Steve Palmer
LINZ	Marcus Girvan
MDC	Garth Nixon and Toni Morrison
NZDF	Sam Staley
NZTA	John Keenan

Appendix 2: Landholder Discussion Questions

	Name:	Date:
	Property:	
	Contact details – (check):	
1	What is the area of the property?	
2	What area is established as planted forest and what is the species?	
3	What area/percent is affected by wilding pine spread?	
4	What are the main species of wildings?	
5	What is the main source of wilding tree seed?	
6	How are you affected by spread from neighbouring landholders?	
7	How do your trees affect neighbouring properties?	
8	What have you historically done to control wilding spread?	
9	Have you and how have you used grazing to control wilding spread?	
10	How long have you been doing wilding control?	
11	Do you have a long term plan/goal?	
12	What is the average cost in dollars per year? (over the last 5 years)	
13	What is the cost in person hours per year? (over the last 5 years)	

14	Have you had assistance from others or agencies with wilding control (either in kind or $)? Are you prepared to provide summary details of this assistance?
15	The Crown has produced a National Wilding Tree Control Strategy – are you aware of it/read it?
16	If you have read it do you support the concepts and principles it outlines including the cost sharing proposals?
17	In the future are you prepared to be part of a collaborative scheme and strategy to manage wilding trees in the Mackenzie Basin?
18	Would you be prepared to put in $ on a per annum basis if the Crown, Regional Council provided financial assistance to wilding tree control in the Mackenzie?
19	Map the areas affected by wilding spread in following categories: Density • Dense • Moderate • Sparse • Outliers • Age Category • Coning • Pre-coning • Seedling
20	Map the areas where control has taken place in the past.
21	Other comments:

Appendix 3: Summary of individual landholder responses to interviews

Summary of Individual Landholder Responses to Interviews

							Wilding Species								Control technique						Grazing										
No	Property Area has	Planted forest has	Shelter belts	Area affected by spread has	Neighbour source	Neighbour affect	P. contorta	P. sylvestris	P. nigra	D. fir	L. decidua	P. ponderosa	P. mugo	P. SPP	Spray	Cut	Hand Pulling	Mechanical	Heli	Cultivation	Standard grazing	Specific management grazing i.e.mob stocking	Years Wilding Control	Long Term Plan	Average Cost / annum over 5 years	Average person days/ annum over 5 years	Assistance from others Awareness of National Strategy		Supportive of principles	Collaboration	1:1 dollar
1	2200	0.5	Y	2100	Y	Y	Y			Y	Y					Y		Y	Y		Y	N	16	N	10,000	15	Y	Y	Y	Y	Y
2	3495	73	Y	70	Y	Y	Y		Y						Y	Y					N	Y	15	Y	15,000	0	Y	Y	Y	Y	Y
3	225	175	N	225	Y	Y	Y		Y								Y				N	N	16	Y	0	4	N	Y	YQ	Y	Y
4	3900	200	Y	3900	Y	Y	Y													Y	N	Y	15	Y	125000	0	N	Y	Y	Y	YQ
5	880	0	N	0	N	N															Y	N	1	Y	0	0	N	Y	Y	Y	YQ
6	2620	0	N	260	Y	N	Y														N	Y	15	Y	0	0	N	Y	Y	Y	YQ
7	780	200	Y	780	Y	Y	Y													Y	N	N	1	Y	0	0	N	Y	Y	Y	YQ
8	3800	36	Y	3800	Y	Y	Y			Y	Y					Y	Y	Y			Y	N	15	Y	400,000	0	Y	Y	Y	Y	Y
9	2800	0	Y	2800	Y	Y	Y		Y	Y	Y	Y			Y	Y	Y				Y	N	33	Y	NA	200	Y	NA	NA	Y	Y
10	2913	0	Y	1500	N	Y		Y		Y	Y				Y	Y			Y		N	Y	50	Y	0	45	Y	Y	Y	Y	Y
11	484	0	Y	0	Y	Y				Y											N	Y	50	Y	0	0	N	Y	YQ	Y	YQ
12	800	0	Y	800	Y	Y	Y		Y						Y	Y		Y			Y	N	4	Y	35000	210	Y	Y	Y	Y	Y
13	32000	70	Y	13000	Y	Y	Y			Y	Y				Y	Y					Y	N	25	Y	9000	26	Y	Y	Y	Y	Y
14	3850	0	Y	600	Y	N								Y							Y	N	1	Y	0	0	N	NA	NA	Y	Y
15	700	20	Y	0	N	Y	Y		Y									Y			Y	N	14	Y	0	0	N	Y	Y	N	N
16	864	0	N	50	N	N			Y									Y			N	N	1	Y	2000	1	N	Y	NA	Y	Y
17	160	0	Y	0	N	N			Y	Y		Y									Y	N	18	Y	0	0	N	Y	Y	Y	Y
18	3664	0	Y	3100	Y	Y	Y	Y	Y		Y				Y	Y			Y		Y	N	12	Y	0	10	N	Y	Y	Y	Y
19	2100	0	y	300	Y	N	Y	Y	Y	Y		Y	Y		Y	Y			Y		Y	N	10	Y	5000	10	Y	Y	Y	Y	Y
20	4000	0	Y	3000	Y	N	Y		Y						Y	Y			Y		Y	N	8	Y	3000	2	Y	Y	Y	Y	Y
21	4900	0	Y	1600	Y	N	Y								Y	Y					Y	N	10	Y	1500	5	Y	Y	Y	Y	Y
22	8000	0	Y	8000	Y	N	Y								Y	Y			Y		Y	N	15	Y	2000	3	Y	Y	Y	Y	Y
23	22000	2	Y	21000	Y	N	Y		Y						Y	Y	Y		Y		N	Y	35	Y	10000	130	Y	Y	Y	Y	Y
24	14500	0	Y	1000	Y	N	Y		Y						Y	Y			Y		Y	N	10	Y	5000	30	Y	Y	Y	Y	Y
25	20072	0	Y	700	Y	N										Y					N	N	20	Y	3000	4	Y	Y	Y	Y	YQ
26	22000	0	Y	13200	Y	N	Y								Y	Y			Y		Y	N	8	Y	15000	3	Y	Y	Y	Y	Y
27	14000	4	Y	7000	Y	N	Y								Y	Y					Y	N	10	Y	20000	0	Y	Y	Y	Y	Y

Summary of Individual Landholder Responses to Interviews

							Wilding Species								Control technique						Grazing											
No	Property Area has	Planted forest has	Shelter belts	Area affected by spread has	Neighbour source	Neighbour affect	P. contorta	P. sylvestris	P. nigra	D. fir	L. decidua	P. ponderosa	P. mugo	P. SPP	Spray	Cut	Hand Pulling	Mechanical	Heli	Cultivation	Standard grazing	Specific management grazing i.e.mob stocking	Years Wilding Control	Long Term Plan	Average Cost / annum over 5 years	Average person days/ annum over 5 years	Assistance from others Awareness of National Strategy		Supportive of principles	Collaboration	1:1 dollar	
28	7534	2	Y	7534	Y	N	Y		Y	Y	Y	Y				Y					N	Y	50	Y	6000	15	Y	Y	N	Y	YQ	
29	1055	4	Y	1500	Y	N	Y									Y	Y				Y	N	30	Y	0	4	Y	Y	Y	Y	Y	
30	8500	120	Y	8500	Y	Y	Y														N	Y	15	y	10000	10	N	Y	Y	Y	Y	
31	14485	25	Y	14485	Y	N	Y								Y	Y					Y	Y	15	Y	0	12.5	N	Y	Y	YQ	Y	
32	19000	20	Y	400	Y	Y	Y		Y						Y	Y					N	N	15	Y	5000	12	Y	Y	Y	Y	Y	
33	1214	5	Y	550	N	Y					Y				Y	Y			Y		Y	N	5	Y	3000	5	Y	Y	Y	Y	Y	
34	1620	20	N	1300	N	Y			Y		Y				Y	Y					Y	N	5	Y	0	0	N	Y	Y	Y	Y	
35	4170	7	Y	1500	Y	N	Y		Y		Y				Y	Y					Y	N	30	Y	20000	15	Y	Y	YQ	YQ	Y	
36	501	0	Y	50	Y	N	Y		Y		Y					Y					Y	N	20	Y	0	1	N	NA	NA	Y	NA	
37	3508	12	Y	3508	Y	N			Y		Y				Y	Y	Y				N	Y	30	Y	5000	5	N	Y	Y	YQ	YQ	
38	9700	400	Y	9700	Y	Y	Y	Y	Y		Y				Y	Y					N	Y	40	Y	5000	30	N	Y	Y	Y	Y	
39	9800	0	Y	9000	Y	Y	Y				Y				Y	Y	Y		Y		N	Y	3	Y	40000	80	Y	Y	YQ	Y	YQ	
40	8000	2	Y	6000	Y	Y	Y		Y		Y	Y			Y						Y	N	20	Y	8000	3	N	Y	YQ	Y	YQ	
41	4500	20	Y	700	Y	N	Y								Y			Y			Y	N	20	Y	40000	40	Y	Y	Y	Y	YQ	
42	3000	0	Y	0	Y	N	Y		Y		Y					Y		Y			N	Y	8	Y	12000	80	N	N	YQ	Y	YQ	
43	10000	4	Y	10000	Y	Y	Y									Y					Y	Y	15	Y	5000	0	N	Y	NA	Y	Y	
44	1200	2	N	240	Y	N	Y		Y			Y			Y	Y					N	N	5	Y	5000	0	N	Y	NA	Y	Y	
45	1514	18	N	1514	Y	Y	Y		Y						Y		Y				N	N	8	Y	50000	0	N	Y	YQ	YQ	NA	
46	66	0	N	60	Y	Y	Y									Y	Y	Y			N	N	4	Y	5000	30	N	Y	N	Y	YQ	
47	55	0	N	47	Y	Y	Y											Y			N	N	5	Y	0	100	N	Y	Y	Y	Y	
48	344	20	Y	103	N	Y					Y					Y					Y	N	17	Y	1000	5	N	Y	Y	Y	Y	
49	742	8	Y	40	Y	Y			Y			Y				Y	Y				N	N	18	Y	0	37	Y	Y	Y	Y	Y	
50	165	165	N	165	N	Y	Y									Y					N	N	10	N	0	5	N	Y	Y	Y	Y	
51	2000	10	Y	1100	Y	Y			Y							Y					Y	N	5	Y	0	10	N	Y	Y	Y	NA	
52	400	0	Y	0	N	N															Y	N	0	Y	0	0	N	N	N	Y	NA	
53	40	0	N	40	Y	Y	Y														N	N	0	Y	0	0	N	Y	Y	Y	YQ	
Total	290820	1645		166821																			821		880500	1198						

Appendix 4: Summary of responses from landholder interviews

Summary of responses from landholder interviews

						Wilding Species								Control technique						Grazing										
All Properties		Planted forest	Shelter belts	Neighbour source	Neighbour affect	P. contorta	P. sylvestris	P. nigra	D. fir	L. decidua	P. ponderosa	P. mugo	P. SPP	Spray	Cut	Hand Pulling	Mechanical	Heli	Cultivation	Standard grazing	Specific management grazing i.e.mob stocking	Long Term Plan	Average Cost / annum over 5 years	Average person days/ annum over 5 years	Assistance from others	Awareness of National Strategy	Supportive of principles	Collaboration	1:1 dollar
TOTALS	Y	29	42	43	29	39	4	25	9	17	7	1	1	26	36	10	9	11	2	29	14	51			24	48	37	48	34
TOTALS	N	24	11	10	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	39	2			29	2	3	1	1
TOTALS	YQ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	7	4	14
TOTALS	NA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	3	6	0	4
TOTALS	Blank	0	0	0	0	14	49	28	44	36	46	52	52	27	17	43	44	42	51	0	0	0			0	0	0	0	0
PERCENTAGES	Y	55%	79%	81%	55%	74%	8%	47%	17%	32%	13%	2%	2%	49%	68%	19%	17%	21%	4%	55%	26%	96%			45%	91%	70%	91%	64%
PERCENTAGES	N	45%	21%	19%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	45%	74%	4%			55%	4%	6%	2%	2%
PERCENTAGES	YQ	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			0%	0%	13%	8%	26%
PERCENTAGES	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			0%	6%	11%	0%	8%
PERCENTAGES	Blank	0%	0%	0%	0%	26%	92%	53%	83%	68%	87%	98%	98%	51%	32%	81%	83%	79%	96%	0%	0%	0%			0%	0%	0%	0%	0%
PERCENTAGES	Total	100%	100%	100%	100%	####	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%			100%	100%	100%	100%	100%
Total Reponses	53																												
Total Value:Private contribution		$1,359,500																					$ 880,500	$479,000					
Total Value:Agency contribution		$ 870,000																					$ 692,000	$178,000					
Total		$2,229,500																					$1,572,500	$657,000					

Key:
Y = Yes
N = No
YQ = Qualified Yes
NA = Not Available/Applicable
Blank = Nil

Appendix 5: NZWCMS Cost Shares (MPI, 2014)

Table1: Suggested cost shares for collective wilding conifer management

	Preventing spread across boundaries		Control of wildings within one privately occupied property		Control of wildings within one Crown-occupied property	
Legacy plantings and legacy wildings	**Exacerbators:**		**Exacerbators:**		**Exacerbators:**	
	Neighbouring land occupiers who destock or change land-use to reduce grazing pressure	10%	Land occupiers who have wilding conifers	20%	Land occupiers who have wilding conifers (that is, central government agency)	20%
	Land occupiers who have wilding conifers spreading beyond their property	10%				
	Beneficiaries:		**Beneficiaries:**		**Beneficiaries:**	
	Central government	35%	Land occupiers who have wilding conifers	20%	The land occupier who has the wilding conifers (that is, central government agency)	20%
	Regional government	30%	Neighbouring land occupiers/owners who are not currently affected	10%	Neighbouring land occupiers/owners who are not currently affected	10%
	Neighbouring land occupiers/owners	15%	Central government	30%	Central government	30%
			Regional government	20%	Regional government	20%
RMA plantings where specific conditions don't apply	**Exacerbators:**		The suggested cost shares are based on the biosecurity funding principles, which promote efficiency by encouraging parties to: • change their behaviour to reduce the costs of control or risks of wilding conifer spread; • assess whether the benefits of control outweigh the costs; • determine whether control is being delivered cost-effectively. The suggested cost shares are a basis for negotiation, and a guide for designing mechanisms that would result in roughly the right allocation of costs. A group considering collective wilding conifer control should adjust on a site-by-site basis based on fairness or practicality. However, it is considered that in all cases both exacerbators and beneficiaries should bear some of the costs. For further information on how to apply the cost share framework see Appendix III.			
	Neighbouring land occupiers who destock or change their land-use to reduce grazing pressure	15%				
	Land occupiers/owners who have wilding conifers spreading beyond their property	15%				
	Local government	25%				
	Beneficiaries:					
	Central government	10%				
	Regional government	20%				
	Neighbouring land occupiers	15%				
Future planting of high risk species	**Exacerbators:**					
	Land occupiers who plant high risk species	80%				
	Neighbouring land occupiers who destock or change their land-use to reduce grazing pressure	10%				
	Beneficiaries:					
	Central government					
	Regional government	10%				
	Neighbouring land occupiers					

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Appendix 6: Abbreviations used in this report

CA	Conservation Area
DOC	Department of Conservation
ECAN	Environment Canterbury
ETS	Emissions Trading Scheme
LENZ	Land Environments New Zealand
LINZ	Land Information New Zealand
MDC	Mackenzie District Council
MPI	Ministry for Primary Industries
MU	Management Unit
MWCM Strategy	Mackenzie Wilding Conifer Management Strategy
MWCM Zone	Mackenzie Wilding Conifer Management Zone
NZDF	New Zealand Defence Force
NZTA	New Zealand Transport Authority
NZWCMS	New Zealand Wilding Conifer Management Strategy
OSTD	Oversown and Topdressed
PCL	Public Conservation Land
SZ	Sub Zone
WDC	Waitaki District Council

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