

# **MANAGEMENT PLAN FOR CORONET FOREST ARROWTOWN**



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Prepared for: Queenstown Lakes District Council & Central Otago District Council

Prepared By: Briana Pringle, BForSc, Parks and Reserves Officer (Forestry), Queenstown Lakes District Council.

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## SUMMARY

This management plan has been prepared by QLDC and describes the management proposals and revegetation recommended for a 2017 harvest. This plan uses estimates based on recent industry averages, conventional harvest engineering methodology and current knowledge.

The QLDC and CODC have an opportunity to harvest the Coronet Forest before full maturity, in order to mitigate the wilding threat and re-establish the site with more suitable vegetation. A full harvest now is a solution for dealing with the wider wilding spread that retention of the Forest will inevitably continue to contribute. Just harvesting the oldest stands will not solve the problem as the younger stands at the top of the Forest will continue to spread seed in high winds.

The Forest remains a significant seed source and contributor to the wilding pine issue. Future regulation arising from initiatives such as the Regional Pest Management Strategy (RPMS) may require the QLDC and CODC to reduce or eliminate the spread of Douglas fir from the Forest. This includes potentially being liable for lands outside the Forest now affected by infestations.

Some private landowners who own sizable wilding plantations are reluctant to participate in programs to remove the trees on the grounds that the Council is a massive wilding seed contributor. If a harvest now is implemented, these landowners may be willing to remove their trees.

In 2016 a more detailed survey of the wilding spread from the Coronet Forest was completed, this report increased the control area from 4km behind the Forest to 10km (and now included Crown Peak and the faces along the Crown Range). The cost to control the spread from the Forest if it was harvested at maturity (youngest stands in 2039) has increased to an estimated \$8.5 million to control around 5,500 ha of infested land.

The harvest plan provides a breakdown of staging within the Forest and gives an overview of the proposed road and landing locations as well as the harvest method throughout the Forest (ground based or cable) and direction of extraction. It has been projected that the harvest will produce 67,940 m<sup>3</sup> of recoverable log product from the Forest. The duration of the harvest has been estimated to be around a two-year duration, given the current market and the economics of harvesting most of the crop may be destined for an export market.

There is an opportunity for the community to realise additional valuable products from the Forest such as firewood, bio fuels and essential oil. The expected volume and log grade output calculated from the pre harvest inventory did not assess these products as the current local market is unknown. This management plan primarily investigates the log resource which the forest was grown for and there will be opportunities to investigate these markets further.

The agreement between QLDC and CODC is a joint venture for the one rotation of the forest, there is no obligation for CODC to remain in partnership with QLDC post-harvest or to re-establish or revegetate the land. Revegetation of the site is subject to conditions under the Emissions trading scheme and also the Operative and Proposed District Plans.

As the Coronet Forest is very prominent within the Wakatipu Basin, one of the key objective of the revegetation program is to promote vegetation the site as soon as possible after harvest to reduce the visual disturbance of the site. Another is to prevent the establishment of competing woody weeds, especially Douglas fir seedlings.

The plan is to establish 30% the site with planted beech forest, a further 10% of the site will be planted in grey shrub-land species and at higher altitudes tussock alpine species. The remaining 60% of the site will be revegetated with introduced grasses initially to suppress woody weeds, but to promote the establishment of a vegetation cover across the site.

Control of Douglas fir on the site is key in establishing a second rotation crop, not only does Douglas fir have to be controlled within the harvested area, but all seeding sources surrounding the forest will need to be removed to create a successful indigenous vegetation cover.

The planting will occur over three to four years and the plan is to carry out weed control over a ten year period from harvest.

## **DISCLAIMER**

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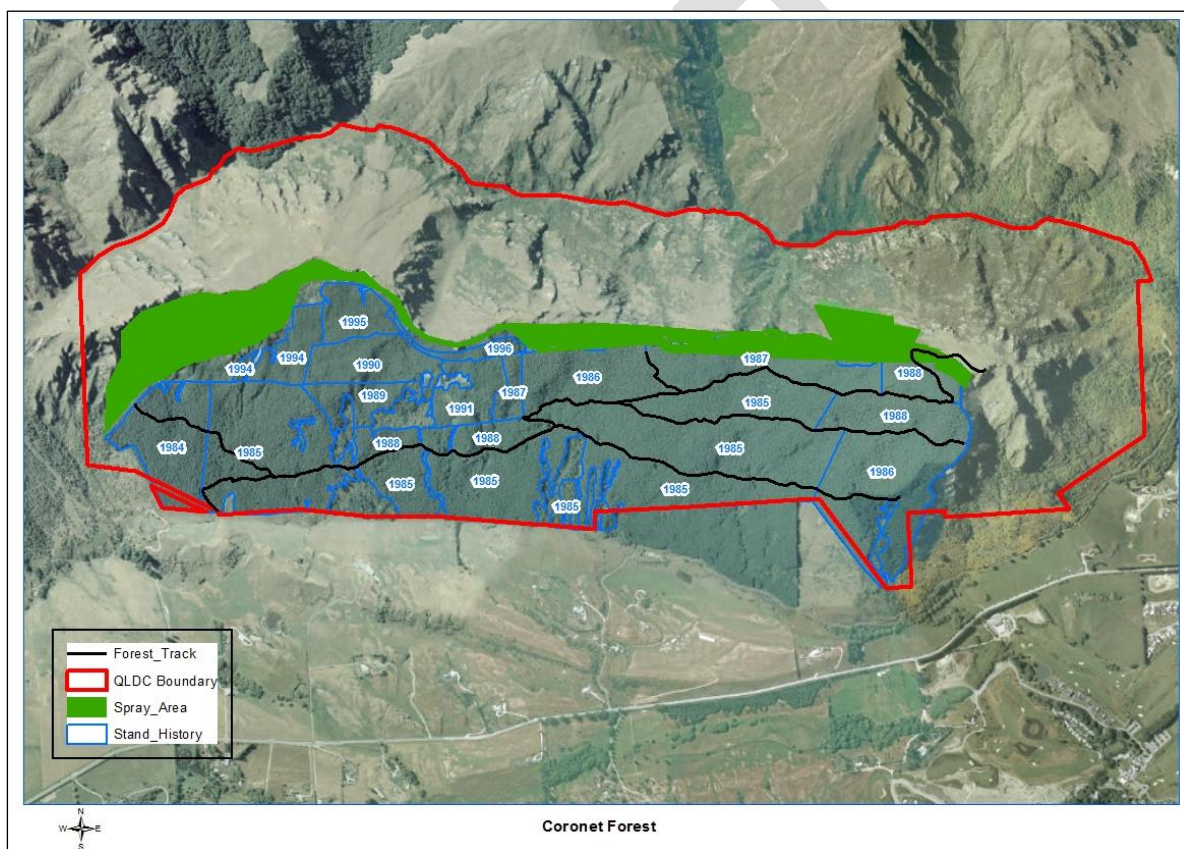
QLDC has compiled this plan and its associated financial analysis. Much of the information used to calculate costs and revenues is best estimate of what will be incurred or earned in future years. These estimates are based on recent industry averages, conventional harvest engineering methodology and current knowledge. Actual returns from this investment may be different from the returns calculated in this plan due to uncontrollable events.

## BACKGROUND

### LOCATION

Coronet Forest is located on the lower slopes of Coronet Peak close to Arrowtown. The site is steep with a southerly aspect and rises to about 650 meters above sea level. The Forest is accessed by Alan Reid Road which is a metalled public road off Malaghans Road. The land adjoins pastoral lease land to the north, run by Coronet Peak Station, and rural residential land to the south. Arrowtown Township is 1 km to the east. The Forest is highly visible throughout the Wakatipu Basin (Figure 1).

**Figure 1: Aerial of Coronet forest**



### LEGAL DESCRIPTION/JOINT VENTURE

The trees occupy an effective Net Stocked Area of approximately 172 ha on four separate Titles with a combined total area of 422.08 ha.

The legal description of the land the Forest occupies is:

Lot 1 DP 24277 and Lots 1 and 2 DP 21922 and Section 24 Block XVII and Section 23 Block XVIII Shotover Survey District, comprised within Certificate of Title 16B/451 of the Otago Registry.

The land is encumbered by lease 617100 to the Central Otago District Council (CODC) and Queenstown Lakes District Council (QLDC) for a term of 60 years from the 1st April 1983. The registered owner of the property is QLDC<sup>1</sup>.

The agreement between the QLDC and CODC is a joint venture and the asset is shared 75% with the QLDC, and 25% with CODC. The lease shall continue until the joint venture property is sold or otherwise disposed of, current management costs are split 75/25 between the QLDC and CODC.

## LAND RENTAL

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The land is owned by the Queenstown Lakes District Council, and is under rental to the joint venture.

The most recent valuation at 13th March 2008 valued the current market rental value of the land at \$20,000 per annum.

The area of land rented is 413ha (Figure 1), only the southern face contains forest, the remainder of the land is not currently administered. The land has an east to west ridgeline running through it; the unplanted land is north facing falling towards Bush Creek, and is now populated with scattered young wilding Douglas fir. The land directly to the east has wilding Larch, Douglas fir and Sycamore present.

## SITE CHARACTERISTICS

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**Soils:** The south facing slope has Brown Dunstan soils, with moderate fertility, but are very good forest soils. The north facing slope consists of Pallic Arrow soils with low fertility. The soils are prone to wind and sheet erosion, severe frost heave, and some landslides.

**Climate:** The average rainfall is 901-1,250 mm and the average air temperature is 8.5 -9 degrees Celsius (Otago Grow 2016).

**Altitude:** The Forest lies between an altitude of 500 metres and 1100 metres above sea level.

**Topography:** The topography of this Forest is a relatively uniform lower mountain slope of moderate to steep contour, and with a number of shelves of easy contour. There is an historic slip near the middle of the Forest which is slowly being stabilised by the trees. Rock outcrops occur on some ridges and spurs, but the site is not excessively rocky.

**Geology:** Coronet Forest is close to a number of smaller fault lines such as the Shotover fault. The underlying rock formation on Coronet Forest is metamorphic rock of the Haast Schist Group –

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<sup>1</sup> The lease was originally between the Arrowtown Borough Council (as Lessor), the Alexandra Borough Council, the Arrowtown Borough Council, and the Queenstown Borough Council (as lessees). A deed dated 1993 transferred the ownership to QLDC and lessee to QLDC & CODC.



Chlorite subzone 4, which is coarsely foliated schist including some biotite schist, from the Permian to Carboniferous periods.

## **VEGETATION**

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The original vegetation (before planting) was a mixture of tussock and introduced grasses, some native shrub species including Matagouri and Tutu, with and extensive cover of the introduced weed Sweet Briar, and Broom in the lower altitudes. In addition to tussocks and some introduced grasses, snow berry, Dracophyllum spp, wild Spaniard and sub-alpine herbs at the higher altitudes. It is highly likely that native beech forest – especially mountain beech – clothed the lower slopes until destroyed by early European or pre- European fires (Guild 2001).

## **CURRENT USE OF THE FOREST**

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The Forest has several recreational uses such as horse riding, hunting and walking, but the only formal agreement is with the Wakatipu Riding Club, this was recently renewed in 2015 for another term of five years till 31 October 2020.

Under the licence the Wakatipu Riding Club must be given two weeks' notice in writing to cease using the facility whilst forestry operations take place and the, licensee can resume operations when written confirmation is received that operations have ceased.

There are spectacular views from the top of ridge and the Forest has potential for greater recreational use, such as mountain biking and walking tracks, authorised horse trekking activities, or a loop track to Bushy Creek connecting to Arrowtown.

## **DISTRICT PLAN & DESIGNATION**

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The zoning of the land under the QLDC Operative District Plan is Rural General, and the Forest has been designated for the purpose of forestry operations, which means the use of the land primarily for the purpose of planting, tending, managing and harvesting of trees for timber or wood production.

Designation 375 allows QLDC to carry out forestry operations in the area known as Coronet Forest.

In summary QLDC is required to undertake these operations under the following conditions:

*Operations must be undertaken in accordance with best management practices as specified under the NZ Environmental Code of Practice for Plantation Forestry Operations. For reference the current version of this is dated May 2008 and is readily available on the NZ Forest Owners website*

<http://www.nzfoa.org.nz/resources/file-libraries-resources/codes-of-practice/44-environmental-code-of-practice/file>

The designation specifies that all management plan updates shall address re-establishment of forest following harvesting operations. This includes the detail of plant schedules, density of planting, and maintenance programs. The designation also states that management of wilding regeneration should be addressed following a harvest operation.

## **EMISSIONS TRADING SCHEME (ETS)**

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The Emissions Trading Scheme (ETS) is New Zealand's main tool for reducing emissions. Forestry was brought into the ETS on the 1st January 2008.

Forestry is New Zealand's largest potential carbon 'sink'. As trees grow, they absorb carbon. When trees are harvested, carbon that is stored is released back into the atmosphere as the wood decays. At present, all harvested wood taken off site is assumed to be immediately released back into the atmosphere.

The emissions trading scheme has two classes of forests Non-Kyoto Forests (pre-1990 forests) and Kyoto Forests' (post-1989 forests).

**Non-Kyoto Forest Land** - Owners of pre-1990 Forest Land are automatically entered into ETS, and incur obligations under the scheme if they deforest, they also receive a one-off allocation of NZUs to help offset the decrease in land value due to decreased land-use flexibility. In 2013 due to the loss in land value, QLDC as the landowner was allocated NZ units/carbon credits for 84% of the Coronet Forest.

QLDC's liability under the ETS is that once the forest has been harvested it must be revegetated with a crop which meets the definition of a Forest<sup>2</sup>, or submit an emissions return to Ministry for Primary Industries (MPI), and pay units for deforestation (at age 33, this equates to around 763 Carbon units per ha, *MPI- carbon stock look-up tables*). At a carbon price of \$17.50 in January 2017 ([www.comtrade.co.nz](http://www.comtrade.co.nz)), this liability equates to \$13,352 per ha.

**Kyoto Forest Land** - Owners of post-1989 Forest Land - can choose to enter the scheme and earn New Zealand Units (NZUs) as their forests grow. QLDC as landowner decided not to enter any of the Coronet Forest post-1989 land into the scheme as these trees are situated at a higher altitude where carbon sequestration is slower, and due to siting and prevailing wind direction these trees can displace seed for many kilometres onto susceptible land.

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<sup>2</sup> The ETS defines a forest or forest land as; At least 1.0 hectare of trees which have (or will have) tree crown cover from forest species of more than 30% in each hectare, with an average width of at least 30 metres. which is capable of reaching five metres in height at maturity in the place they are growing.

## MANAGEMENT

### MANAGEMENT OBJECTIVES

The management objectives of the Forest, is to grow a crop of Douglas fir for maximum profitability within the constraints of:

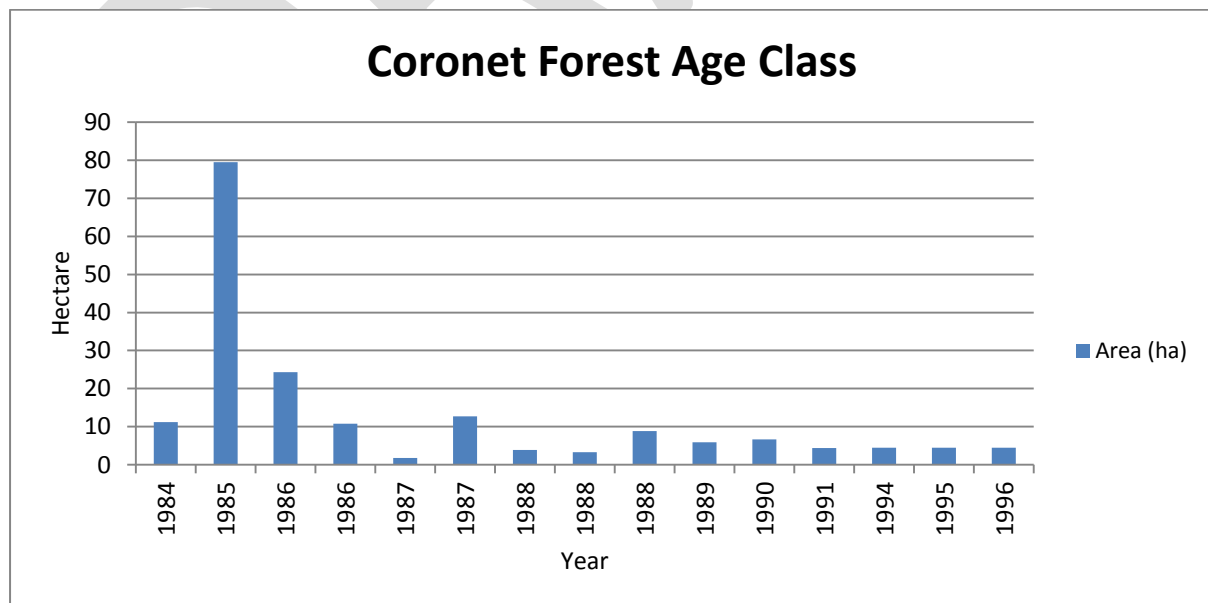
- Good forestry practice
- Sustainable land use, and
- Respecting the wider social objectives (of landscape and public use) of the Queenstown Lakes District Council as contained in the District Plan.

### FOREST AREA

QLDC GIS Team have access to aerial photography and the net stocked area of the forest is updated from this. The aerial photography has enabled the Forest stand boundaries to be mapped. All forest operations (planting, thinning etc) have been digitised and are stored in a database which provides a history of all events in the forest as well as stocking and area (Figure 1: Aerial of Coronet Forest).

The Coronet plantation is a monoculture of Douglas fir (*Pseudotsuga menziesii*), the oldest stand was planted in 1984 and the youngest stand was established in 1996 (Figure 2).

**Figure 2: Coronet Forest Age Class**



The stands were planted at stockings between 2,000 and 1,667 stems per hectare (SPH). A blanking occurred in 1999 and 300 seedlings were planted in gaps caused by mortality.

Within the Forest there were a high proportion of malformed trees due to genetic problems such as double leaders, ramicorn branches, stem wobble and coarse branching. Some trees in the Forest had been damaged by wind and snow causing broken tops and butt sweep. The proportion of malformed trees was what would typically be expected in a stand and scheduled thinning operations removed most of the malformations so that the best formed trees now remain as the final crop.

## **PRE-HARVEST INVENTORY - YIELD ANALYSIS/EXPECTED YIELD**

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A review of the management of the forest was carried out by Forme Consulting in June 2014, this review recommend a full inventory to enable more robust modelling to understand the available yield in a “harvest now” situation for planning, log markets and decision making.

A full inventory is a vital tool in estimating the total stem volume and also the mix of log products that could be expected when the Forest is harvested. This is referred to as the yield from the Forest and is based on a sample of the trees, taken from plots established throughout the forest.

Establishing plots throughout the Forest provides a sample of the stand, enabling a visual assessment of the external tree characteristics such as their dimensions (DBH and HT), straightness, branching, malformation etc. This data can then be assessed using growth models and anticipated market log specifications for varying clearfell ages.

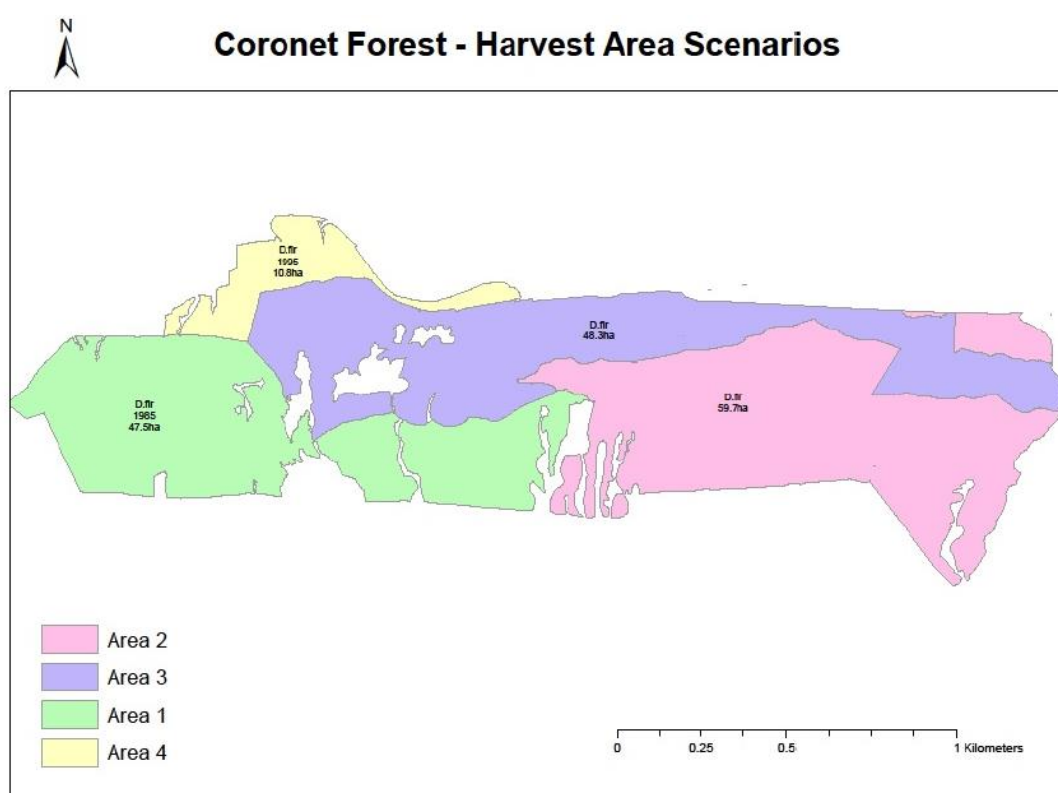
The first step in deriving estimates of future volume is to stratify the forest into crop types. Each crop type is then clearly defined, and mapped. Crop types may be distinguished from one another by species, age class, silvicultural treatment, or productivity. Coronet Forest is remarkably uniform, being just one species, and of similar growth throughout.

Interpine Forestry Innovation carried out an inventory of the Coronet Forest in January 2016, the forest was stratified into four sampling/crop types areas based upon planting age, tending history and stocking (Figure 5 – Coronet Forest Harvest Area Scenarios). The three larger areas were measured as pre-harvest inventory and the youngest stands at the top of the forest were measured as mid rotation inventory. Area 1 had received two thinning to waste operations and Areas 2, 3, 4 had only received a single thin to waste<sup>3</sup> operation.

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<sup>3</sup> ‘Thin to waste’ is the silvicultural practice of removing selected trees to promote the rapid growth of the crop trees, to waste is where the trees are left on the forest floor, production is where the trees are removed for use

**Figure 5: Coronet Forest by Crop Type – Harvest Area Scenarios**



A total of 112 plots were [set up and](#) measured across all areas. The plots were sized to allow the measurement of 17-20 trees per plot which meant the average plot size was between 0.03 ha and 0.04 ha.

The data recorded in the inventory was entered into YTGen (Yield Table Generator) software which generates the expected yield tables for a harvest using the South Island Douglas Fir 1 (SIDFIR\_1) Growth Model. It combines the process of growing and projecting tree volumes with log bucking algorithms to model tree merchandising through to log products.

In order to generate the expected volumes by log grade, a cutting strategy is devised. The cutting strategy utilised the current Douglas fir log prices obtained from exporters in the Southern South Island outlined below in Figure 6.

**Figure 6: Export Log Grade Specification Utilised in the Cutting Strategy**

	Min. SED	Max. SED	Max. LED	Lengths	Branch size	\$/m3 JAS
<b>CF+</b>	30	N/A	N/A	3.9, 5.9	<= 12 cm	135
<b>CF-</b>	20	N/A	N/A	3.9, 5.9	<= 12 cm	125
<b>CF16</b>	16	45	45	3.9	<= 22 cm	112

The yield analysis prepared by Interpine were reviewed and summarised (Forme 2016), Figure 7 below shows the total volume of recoverable wood product for the whole forest is 67,940 m<sup>3</sup>.

Please note that no allowance for firewood volume has been included at this stage. The analysis below only details log products produced in the cutting strategy detailed in Figure 6.

**Figure 7: The expected volume and grade output at 2017**

Population	Established	Current Age	Area (ha)	Recoverable Volume m3/ha	Total Recoverable Volume m/3
				2017	2017
Area 1	1984, 1985	30.9	47.5	509.3	24,192
Area 2	1986, 1987	30	59.7	446.6	26,662
Area 3	1986, 1987 1988, 1999 1990, 1991	27.4	48.3	325.3	15,712
Area 4	1994, 1995 1996	20.7	10.8	127.2	1,374
<b>Total</b>			<b>166.3</b>	<b>408.5</b>	<b>67,940</b>

The estimates produced from the inventory are only as good as the data being used, and the models themselves, nevertheless, the information provided by such programs is of immense value in providing a base on which to plan the harvest.

**Notes:**

1. Current age assumed as average at each age classes in population.
2. Recoverable volumes at 2017 as per Interpines yield analysis
3. The area stated in Figure 7 is less than the reported stocked area due to the trees that are not of size to be classified as merchantable and exclusion of trees affected by wilding spray.

## **FOREST VALUE**

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The Forest is valued annually for the purposes of reporting the value of the asset in the respective owners' accounts. The value represented in the current accounts is the "current" value or value that the Forest is worth if it's sold in its immature state. The valuation is for the trees only, as the land is not for sale.

The valuation at the 30th of June 2016 was \$1,149,695, this was calculated by Laurie Forestry Ltd a Forestry Consultant Group registered by the NZ Institute of Forestry Inc.

## WILDING CONTROL

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Douglas fir is considered a wilding species in the Wakatipu and aggressively establishes itself in areas of un-grazed tussock land. Wilding spread especially occurs in the direction of the prevailing wind.

In 2005 and 2006; 8.8ha of planted trees at the top of the Forest in the bush creek catchment area were cleared, this was undertaken to reduce the risk of wilding spread.

A containment line was boom sprayed across the top of the Forest in 2010, the idea behind this was to help prevent seedling take off along the ridge of the Forest by creating a wall of standing dead trees which would act as a barrier to the spreading seed. However due to the increase in seed below, and prevailing wind direction, seed is continually blown up the faces and deposited many kilometres over the land behind the Forest.

Wilding conifers can grow well above the natural beech tree line, which is between 900 and 1,100 meters in Otago. Wilding Douglas firs have been found above 1,400m on the range behind the Coronet Forest.

A visual inspection of the land behind the Forest indicates the significant population of young seedling reappearing in the open tussock land. As the Forest, has matured a significant number of wilding Douglas fir seedlings are now appearing on Coronet Peak Station, and up above the Crown terraces on the Crown Range as high as Crown Peak (Figure 8).

As altitude increases so does wind speed, the Douglas fir planted along the top ridges of Coronet Forest disperse seed vast distances due to the increased wind speed at these altitudes. Seed dispersal is mainly by wind. While much of the seed falls within about 60m of the parent on flat sites, dispersal distances of several km are common in the South Island (Hunter & Douglas 1984).

Distances of up to 40km are possible in very strong winds (Ledgard 2001, 2009). If left undisturbed these outlier trees can produce seed within ten years and masses of consequent wildings within 15 years.

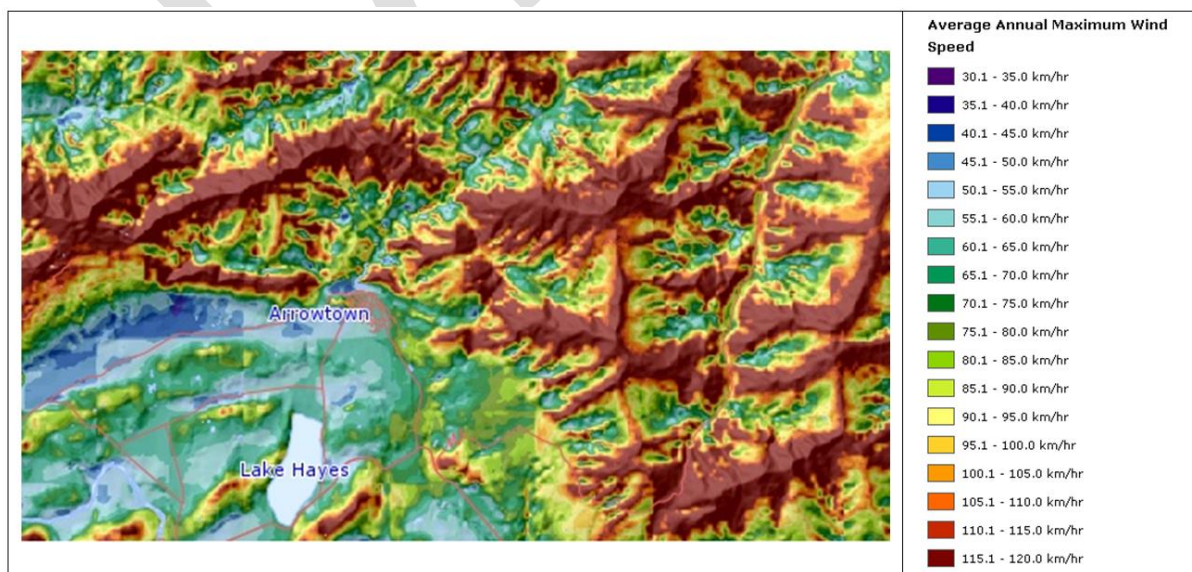


**Figure 8: Crown Peak and Crown Range above Arrowtown, taken from the top of the Forest**



Figure 9 below shows the average annual maximum wind speed around the Forest, the darker colour represents the highest wind speed (115-120 km/hr) and is located along the top of ridges. Coning windings positioned at on ridge tops will disperse seed vast distances due to the increased wind speed at these altitudes.

**Figure 9: Average annual maximum wind speed on Coronet Forest (Otago Grow, 2016)**





**Figure 10: Wilding Spread below Brow Peak behind the Forest**



**Figure 11: Wilding Spread from Coronet Forest in Sawpit Gully**



The Coronet Forest will produce constant seed rain onto neighbouring land until harvest, the amount of seed produced from the Forest will continue to increase as the tree crop matures, so there will be an exponential increase of seed produced as the forest ages.

If the Forest is left to maturity without a wilding control program the faces on Coronet Peak Station up behind Arrowtown, areas such as German Hill, Brow Peak and Big Hill, will become exotic forests in a very short time (Figure 10 and 11). A large investment in wilding control in terms of both professional contractor time and volunteer time has already been spent in these areas and in some cases volunteers are now returning to clear an area for a third and fourth time.

The eastern steep faces of the Forest that used to be covered in tussock are now visually a bright green slope, this is a new population of thousands of Douglas fir seedlings, which are growing as thick as grass.

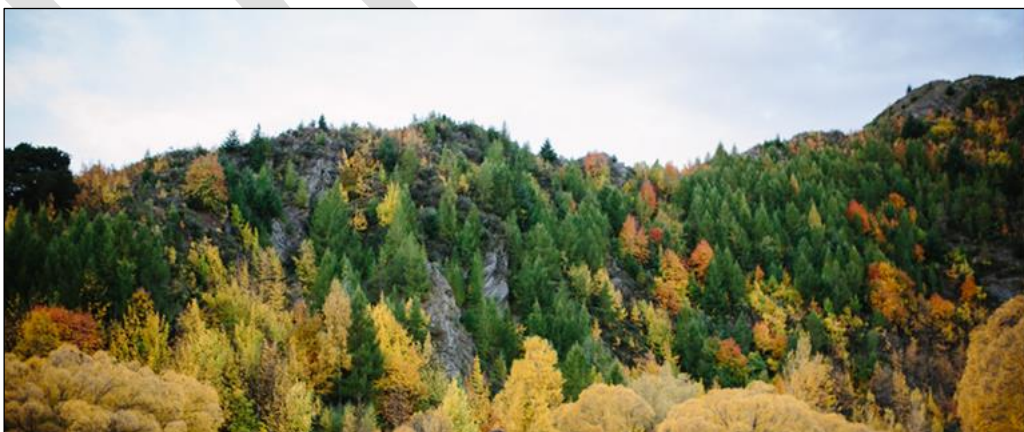
The Wakatipu Wilding Conifer Control Group (WCG<sup>4</sup>) was created in 2009 and along with Coronet Peak Station and Volunteers has invested many hours of control on the faces behind the Forest.

In 2010 it was decided by the WCG executive to discontinue control work up behind the Forest until a commitment to clear the Forest was made. Any wilding free areas behind the Forest in the direction of the prevailing wind are clear (wilding free) as a result of control by local volunteers.

This season wilding conifers are now visible in large numbers up along all of the Crown Terrace faces below Crown Peak. While some of the spread may have come from a number of shelter belts below and single mature conifers, in a recent aerial survey of the area it was clear the majority of the wildings spread would have come from Coronet Forest.

The Douglas fir seed from the Coronet Forest is also affecting the faces directly above Arrowtown, which are recognised internationally for their autumn colours. Douglas fir is a dominant shade tolerant species and the golden colours are gradually changing to dark green (Figure 12).

**Figure 12: Arrowtown Autumn Colours**



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<sup>4</sup> WCG is a community, not-for-profit organisation created in April 2009. It is focused on protecting biodiversity and the remarkable landscape of the Wakatipu for the benefit of residents, users, tourists and particularly, future generations.

The Wakatipu Wilding Conifer Strategy 2013-17 explains that the Wakatipu is now experiencing the consequences of forests that were planted close to areas of Outstanding Natural Landscape with ecological value. It is from these and other smaller scale plantations, shelter belts or pockets of established wildings that further wilding conifers will emanate if containment or removals are not undertaken.

The WCG's strategy work program is to target and remove seed sources or coning trees that are causing on-going wilding issues on vulnerable land, and implements the following 5x5 plan:

- **ALERT** – the community to the exponential spread and cost of wilding control
- **COMMUNICATE** – the WCG programme of control and the projected effects of no control.
- **ERADICATE** – all seeding trees where possible
- **CONTAIN** - non-removable wilding areas and planted forests
- **HAND BACK** - control maintenance to landowners, DOC and QLDC

The legislative framework required to support wilding conifer management is in place through the RMA 1991 and the Biosecurity Act 1993. QLDC has strict rules on new plantings of wilding species under the RMA, but there is nothing that can be done about spreading forestry blocks that were planted prior to the RMA (Coronet Forest is one of these blocks).

The only wilding species that is classified as a 'pest' in Otago under the Bio Security Act is Contorta Pine. The NZ Wilding Conifer Management Strategy 2015-30 released by the Ministry for Primary Industries, suggests good neighbour rules in regards to wilding conifer plantings, but none of these rules are statutory.

The National Wilding Conifer Management Strategy led to \$16 million of new national operating funds being made available in the 2016 Budget to tackle wilding conifers. Approximately \$2.6 million of this funding has been allocated to the Wakatipu over the next four years.

QLDC contributes \$438,063 (increasing to \$500k in 2017/18 long term plan) to the WCG annually to fight the wilding battle. The wilding spread from the Coronet Forest compromises QLDC polices for the maintenance and values of the outstanding natural landscape.

The WCG will spend approximately \$1.4 million dollars on wilding control in the Wakatipu during the 2016/17 season; this includes contributions from QLDC, DOC, ORC, Landowner's, MPI, Business owners and from funding agencies such as Central Lakes Trust and the Lotteries Grants Board.

The cost to control identified land surrounding the Forest up to 4km in distance (aligning with natural boundaries such as Brow Peak and Big Hill) from now until maturity was conservatively estimated and reported to QLDC in 2015 as \$3 million over the life of the Forest. In 2016 a more detailed survey of the area was completed which increased the control area to include the Crown Range to Crown Peak (Figure 8), the cost of control a larger area up to 10 km from the Forest is now estimated at \$8.5 million to control 5,500 ha of land (Appendix 1, Coronet Forest Wilding Work Plan 2017-2039).

The assessment excluded the mature trees on the faces directly behind Arrowtown, the larch up on German Hill or any mature shelter belts, the control program is essentially dealing with the younger spread from the Forest.

The objectives of the management plan are:

- Remove all Douglas fir wildings from the area surrounding the Forest before they reach coning at around 14-16 years.
- Remove scattered wilding outliers from areas of open tussock grasslands and sub-alpine shrublands before they are able to produce cones and seeds and /or establish significant sites for further spread, thus protecting large areas of clear land from the probability of being infested.
- Containment of denser infestations using tools such as sprayed buffer zones
- Create buffers around native beech forest
- Remove conifers from within pockets of native beech forest
- To remove trees from take-off sites such as ridge tops. Take-off sites are a common source of distant spread, as high winds speeds on ridge tops escalate seed spread.
- The management plan recommends boom spraying large tracks of land behind the forest in the direction of the prevailing wind due to the density of seed on the ground. Boom spraying is significantly cheaper than ground control, but covering large areas of land with herbicide will affect woody native species.

#### **PROPOSED SIGNIFICANT NATURAL AREAS**

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Behind the Coronet Forest in the Bush Creek catchment on Coronet Peak Station and QLDC administered land are two 'proposed significant natural areas' (Figure 13) which are documented in the QLDC Proposed District Plan. These areas are noted as "critically under protected" and "chronically threatened" and contain Mountain Beech forest remnants exhibiting a high degree of representativeness. These areas contain the only remaining examples of beech forest on Coronet Peak Station, and within the Shotover Ecological District which survived Polynesian and European fires.



Figure 13: Shows the location of proposed significant natural area G28A\_7 and G28A\_6



- G28A\_7 & G28A\_6 - Beech Forest Remnants– partially within QE2 area

The noted threatened species in the proposed areas are:

- *Falco novaezealandiae* “eastern” (eastern NZ Falcon), at risk but recovering.
- *Acanthistta chloris* (Rifleman)- At Risk - Declining

The proposed significant natural areas are under threat from wilding conifer seed from the Coronet Forest as low stature native vegetation /ecosystems are particularly vulnerable to wilding conifers. Douglas fir will establish in native beech forests with an open or thinning canopy and can lead to the local extinction of native plant communities (Froude 2011).

## FIRE

Fire Control rests with Otago Rural Fire Authority as the Forest is in a rural fire fighting area. Due to the value of the forest the trees are covered by a fire insurance policy.

## **FENCING, TRACKING AND ROADING**

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There is a boundary fence around the older plantings (1984 to 1991), this area was fenced to protect the young trees from sheep browsing. There is no fence around the younger planting at the higher altitude.

The only tracks/roads on the property are the establishment tracks formed at the time of planting. These have been repaired from time to time but would not be suitable in their current form for any logging traffic. A major upgrade is required before harvest can be carried out. This upgrade will require widening, some realignment, re-culverting, application of base course and metalling.

DRAFT

## HARVEST PLAN

### BEST PRACTICES, HEALTH AND SAFETY

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**Objective:** To ensure all forestry operations are carried out in accordance with industry best practice and in a way that ensures the health and safety of all involved.

All forestry operations will be carried out using Best Management Practices under the New Zealand Environment Code of Practice for Plantation Forestry. Second Edition May 2008

(<http://www.fitec.org.nz/Resources/NZ-Environmental-Code-of-practice-for-Plantation-Forestry/>).

The code should be referenced and industry expertise sought to plan and implement the correct mitigation methods available so that minimal environmental disturbance occurs on the site.

Regular monitoring or auditing of all operations should be written into Health and safety plans to ensure all consent conditions and best practice are implemented and followed.

All harvest operations in the forest will comply with the relevant sections of the Health and Safety at Work Act 2015 (including subsequent regulations and guidelines) for all persons involved in the work and at the work site.

The Health and Safety Act now places greater responsibility on all participants in an employment relationship which means QLDC, CODC, as well as contracted harvesting, cartage and stumpage sale parties have a critical role to play. All health and safety operating systems should be audited and regular monitoring of these systems should be carried out to ensure a high-performance delivery is achieved.

All operations must comply with the requirements of the Resource Management Act 1991.

All high-risk jobs must be notified to the Worksafe New Zealand.

All contracted third party service providers for harvesting and re-vegetation of the site should have sound accredited health and safety records and industry expertise, as many operations such as aerial spraying, harvesting and log cartage areas are classified as high risk operations.

Strategies for mitigation of harvest risks will not vary significantly within the Forest but everyone will need to remain vigilant throughout the duration of the harvest operation.

### HARVEST PLAN

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A harvest plan will be prepared by a suitably qualified expert prior to harvest of the Forest, this plan will detail the harvest extraction methodology (a mixture of ground based and cable) and include the proposed road and skid site location to process the logs.

The harvest plan will address the following objectives:

- To identify the optimal harvesting methodology for the Forest including and assessment of value recovery.
- To identify the extent of infrastructure required to enable the preferred harvesting methodology to take place.
- To identify key environmental risks associated with harvesting and recommend strategies for the management/mitigation of these.
- To identify key community risks associated with harvesting and recommend strategies for the management/mitigation of these.

## **HARVESTING AND MARKETING OF THE FOREST**

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The Coronet Forest will be managed through a Graded Log Sale, this means the contracted forestry company will manage the entire harvesting and transportation roles and will sell the logs to customers as an agent for the Forest owner.

The harvest plan will be used to procure a forest company to carry out both the harvest operation and sale of the timber on behalf of QLDC and CODC.

Revenues will be dependent on the market conditions monthly. QLDC and CODC may implement a third party audit process over the top of the log sale agreement to provide additional transparency that the accounting and operational monitoring processes systems are robust.

The harvest will place large volumes of Douglas fir into the market and the economics of harvesting may mean that most of the crop is destined for an export market.

Many risks are involved in forestry as future log prices are uncertain, also the Coronet Forest is located some distance to ports and the domestic markets, and the future price of fuel is unknown.

## **DOUGLAS FIR ESSENTIAL OIL & BIO FUELS**

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Wood fuels are a cost-effective and sustainable source of energy. Modern wood-fired burners are clean burning and highly efficient offering instant benefits over fuels such as coal and oil, wood energy and its production can also bring considerable economic benefits to the supply chain.

Forest harvest residues at landings and skid sites could be considered as potential sources of bio fuels. If a viable method for removing the wood is available.

There is an opportunity for the community to realise additional valuable products from the Forest such as essential oil and bio fuels. This management plan primarily investigates the log resource



which the forest was grown for. After the forestry company is appointed there may be opportunities to extract bio fuels and essential oils from the residue of the Forest, if there is commercial interest in these products the operational detail can be included in the day to day planning and log recovery.

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## REVEGETATION

### REVEGETATION OBJECTIVES

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The agreement between QLDC and CODC is to establish, maintain and develop the Coronet Forest for eventual harvest and sale of the timber, after which the joint venture is dissolved. There is no obligation for CODC to remain in partnership with the Council (post-harvest) and re-establish/or re-vegetate the land.

Coronet Forest is subject to provisions of the ETS and the Operative and Proposed District Plans, and both require the revegetation of the site following the harvest of the plantation.

The key project objectives that the revegetation must achieve are:

- To revegetate the site as soon as possible after harvesting to ensure landscape values are improved as efficiently as possible.
- To revegetate the site in a manner that promotes the natural regeneration of native vegetation and provides habitat for native wildlife (e.g. birds, lizards and invertebrates);
- To establish native plantings that are self-sustaining within the site.
- To meet the ETS requirements – 30% coverage of the site by trees greater than five metres in height.
- To promote sustainable use of the site by members of the public via establishment of walkways, biking tracks, horse trekking trails and picnic areas.
- To prevent the establishment of weedy species, e.g. especially Douglas fir seedlings and a range of woody weeds such as briar, hawthorn, sycamore, rowan, broom and gorse.
- To establish an area of biological diversity to help restore the native biodiversity values within the Wakatipu Basin.

QLDC commissioned Davis Consulting Group Ltd (DCG) to prepare a proposal for the revegetation of the Coronet Forest post-harvest with natives (Appendix 2).

In addition, the following options were investigated in the preparation of this plan:

- Natives and grey shrub-land with a predator free fence
- Natives and grey shrub-land
- Mixture of Natives and Exotic Forestry Species
- Exotic Forestry Species

Native and grey shrub-land restoration is the preferred approach to achieve the revegetation objectives as detailed below. A detailed re-vegetation plan will be prepared as part of the outline plan process in accordance with the objectives and detail set out in this plan.

## **NATIVE/GREY SHRUB LAND RESTORATION - GOAT FENCE**

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A detailed proposal for this option is attached in Appendix 2. The proposal should be referred to in detail for the planning of the revegetation project.

The concept is to create a landscape level ecological restoration of the site, with a vision of re-establishing indigenous ecosystem values and also providing a recreational space for the local community and visitors.

The proposal includes the pricing of a goat fence to remove the predator threat and protect the plantings. The most practical fencing approach was to construct a perimeter deer fence around the site with gates at the top and bottom for future public access.

Restoration plantings are normally completed at one metre centres, which allows plants to provide shelter to one another and control weeds efficiently. To achieve 30% coverage of the site, approximately 521,100 mountain beech will be planted into the pasture grass and between windrows within the aerial spray buffer zone (Davis 2016).

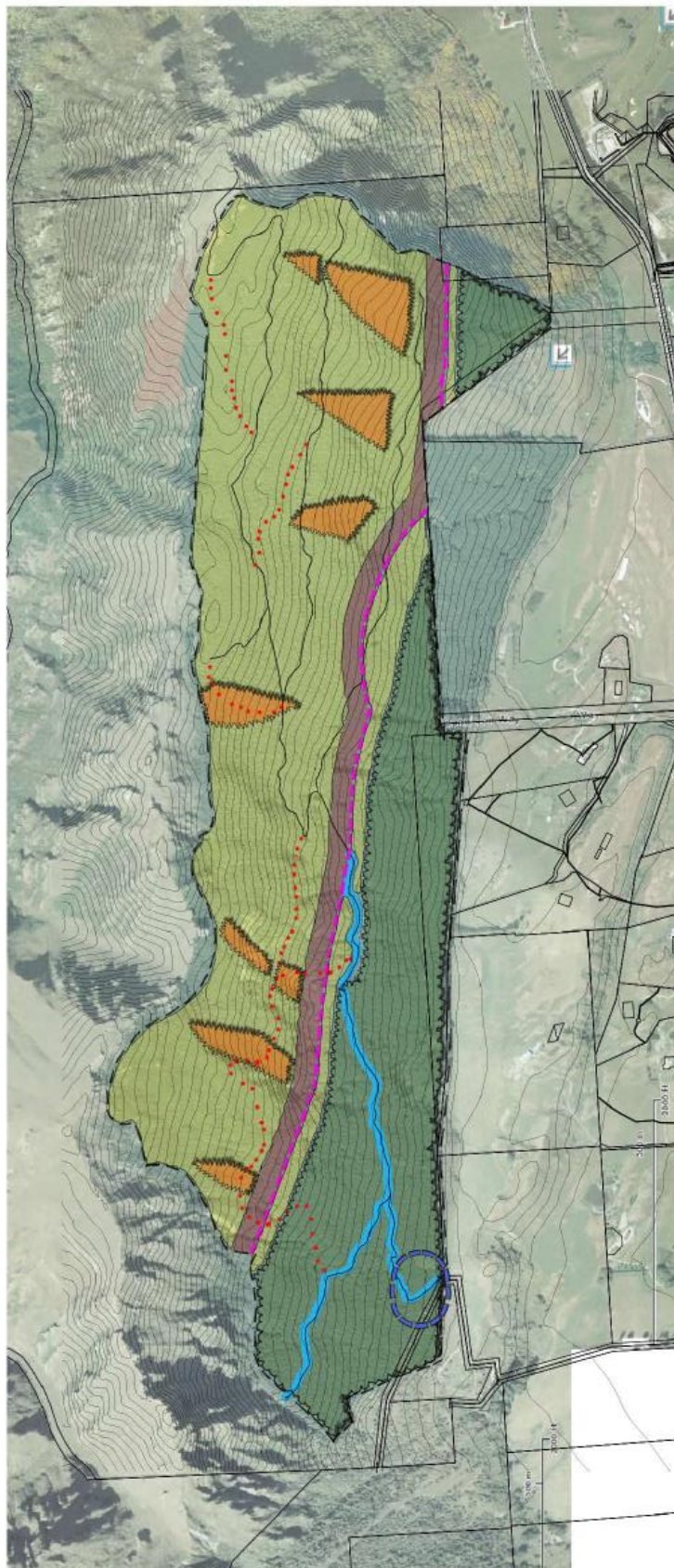
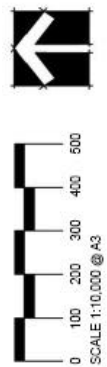
As well as beech trees, 10% of the site will be hand planted in a mix of grey shrubland and tussock species. This will increase biological diversity and the range of habitats for native wildlife species. Grey shrubland is a key habitat for a number native passerine bird species (e.g. fantail and grey warbler), which in turn provides prey for the 'At Risk' New Zealand falcon. In order to achieve a shrubland cover of 10% a total of 173,700 plants will be required to be installed (David 2016).

Tussock grassland will be established above the 550m buffer to establish native vegetation in an area that will be aurally sprayed for weed control post-harvest.

Due to the large-scale landscape level of restoration this project requires, it is not feasible to plant out the whole site. Therefore, providing support for natural regeneration processes is proposed. Natural regeneration is the best mechanism to support landscape scale restoration of the site.

A revegetation landscape plan has been developed for the site Figure 15 and provides a graphical presentation of the proposed vegetation units, and details the self-sustaining native beech forest, grey shrubland and tussock grassland across the site.

Figure 15: Coronet Forest, Revegetation Landscape Plan



# LEGEND

- Hand planting - mountain beech @ 1.0m centres (Fuscospora cliffortioides)
- Hand planting - Grey shrubland species @ 1.0m centres
- Hand planting - Tussock species @ 1.0m centres
- Pasture grasses (via OSD) with colonisation of bracken fern (via human assistance)
- 50m buffer strip of pasture grasses
- Future walking / biking / horseriding trail
- Indicative mountain bike tracks
- Potential for community planting and picnic areas
- Perimeter deer fence
- 500m buffer line

**Project:** CORONET FOREST  
**Title:** REVEGETATION PLAN  
**Location:** QUEENSTOWN

**Rev. Description**  
A ORCA landscape  
**By:** JD  
**Date:** 19/12/16

**Scale:** 1:10,000 @ A3  
**Drawn / Checked:** JD / RL

**Job No:** 2674  
**Date:** 19/12/16  
**Drawing No:** L1A

**NOT FOR CONSTRUCTION**

This drawing is supplied on the understanding that the information herein is for general guidance only and does not constitute a contract. It is the responsibility of the client to ensure that the information is used for the intended purpose and that any necessary variations are made before construction begins.





## REVEGETATION OBLIGATIONS UNDER THE EMISSIONS TRADING SCHEME (ETS)

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The ETS requires that the site is replanted such that 30% of the site will be covered in vegetation that can reach a height of at least 5 metres.

In order for QLDC to meet its obligations under the ETS, 30% or 52 hectares of the site will need to be planted in trees.

For the native option Mountain beech (*Fuscospora cliffortioides*) is the best species to meet this requirement in terms of height (approx. 10-15 m at maturity) and growing ability within the Wakatipu.

## LAND PREPARATION

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Land preparation follows harvest and is usually carried out by the harvest crew. The proposed harvesting operation will be a mixture of ground based and cable/hauler logging. The cable/hauler harvesting system will result in a relatively clean post-harvest site as trees are felled on site and hauled to skid site for processing where accumulation of slash is significant. This means that the rehabilitation or land preparation operations such as windrowing will be limited to ground based areas only.

Ground based logging will occur on less than half the forest area, therefore around 83 ha will be windrowed, based on the methodology proposed in the current Harvest plan. The windrowing is completed by raking wood debris and waste material into slash rows by an excavator based machine. The windrows will take a long time to degrade and provide a sheltered environment for the ongoing germination and establishment of woody weeds.

As the harvest areas are completed, they will be oversown and topdressed. Oversowing with pasture grasses (e.g. brown top) is the first step in restoring landscape values quickly and will help prevent woody weed establishment. Oversowing and topdressing will occur in the spring or autumn immediately after each of the four areas have been harvested (Figure 17).



**Figure 17: Windrows with surrounding exotic pasture grass near Moke lake (Davis 2016)**



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#### **MAINTENANCE WILDING AND WOODY WEED CONTROL**

The wilding regeneration at this site will be prolific due to the seed in the ground and maximum control required with minimal management intervention.

Post-harvest, it is expected that the site will be subject to rapid woody weed establishment particularly from germinating Douglas fir seed, but also from a range of other weeds hawthorn, sycamore, rowan, briar, broom and gorse (among other weed species). It is noted that broom populated most of the site before it was established as a forest, so there is a seed source for that present.

Control of Douglas fir on the site is key in establishing a second rotation crop, and this will be one of the main goals of the revegetation plan. Not only does Douglas fir have to be controlled within the harvested area, but all seeding sources around the forest will need to be removed to create a successful vegetative cover.

The revegetation plan will detail the weed control for the area over a ten-year period from harvest.

The establishment of pasture grasses on site will help suppress the Douglas fir, but will not prevent it from re-establishing. Therefore, herbicide weed control will still be required. The method of weed control across the site will be determined by the proximity of neighbouring residents. Aerial application is the most efficient method; however, herbicides can only be applied at a distance of 550 metres or more from the nearest residence.

To ensure the efficient and effective control of Douglas fir and other woody weeds is achieved, all areas of the site that are over 550 metres from neighbouring dwellings will be aerially sprayed with metsulfuron or a similar woody weed selective herbicide. The aerial application of herbicide will cover approximately 65% of the site. This herbicide application will target the young Douglas fir growth and other woody weeds, but will not affect the grass and native tussock species which will create a suitable landscape cover. Three aerial applications will be required for this zone.

Weed control within 550m of the nearest dwellings will be carried out via hand-pulling and backpack or truck spray units.

To maximise the performance of the plantings, a landscape maintenance programme will commence immediately prior to the first round of planting. This will remove any weeds that might have established in the interim) and continue for three years after each planting season.

The plant maintenance work to be undertaken will include weed control, rabbit and hare control and a check of the fence line. All of which is required to minimise competition from exotic weeds and animal browse.

Within all hand planted areas, weed control will include the application of herbicide immediately adjacent to each plant shelter and hand pulling of weeds that grow within the plant shelter.

## REVEGETATION COST

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Figure 18 below provides a cost estimate to complete the revegetation projects described for the four options, the cost includes a 20% contingency.

**Figure 18: Provisional Revegetation cost estimate (excluding GST) for the four options.**

Revegetation Options	Cost (Inc. Contingency 20%)
Predator Fence with Native Species	\$17,524,748
Native Species	\$11,937,848
Mix Native and Forestry Species (50/50)	\$8,306,925
Forestry Species	\$4,676,001



The costs are based on preliminary cost estimates obtained from contractors and standard rates used by landscape contractors on smaller projects undertaken within the Wakatipu. Please note, the cost estimate excludes the following costs:

- Project management
- Construction of onsite holding “nursery”
- Track construction and signage
- Monitoring to assess the performance of the project
- Douglas fir control on areas neighbouring the forest, where Douglas fir has established
- Bracken fern establishment above the 550m buffer zone
- Rabbit and hare control – e.g. Plantskydd
- Deer fence check, although this may be able to be included in the goat monitoring estimate
- Freight of plants and materials to site
- Costs of inflation.

## APPENDIX

Appendix 1: Coronet Forest Wilding Work Plan 2017-2039, QLDC, 2016

Appendix 2: Coronet Forest Revegetation Proposal, David Consulting Group, 2017

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