Ministry for Primary Industries
Manatū Ahu Matua

Wood Availability Forecasts – Otago/Southland 2014

Prepared for the Ministry for Primary Industries
by Indufor Asia Pacific Limited

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New Zealand Government

Growing and Protecting New Zealand

Ministry for Primary Industries' Wood Availability Forecasts

A new series of Wood Availability Forecasts is being prepared by Indufor Asia Pacific, for the Ministry for Primary Industries (MPI), covering the period from 2014 to 2050. These forecasts are intended as a planning tool for the forest industry, councils, and infrastructure and service providers. New forecasts for all nine regional wood supply regions will be published over the next eighteen months, along with new national forecasts.

MPI is working in association with the National Exotic Forest Description (NEFD) Steering Committee to prepare the new regional and national wood availability forecasts. NEFD user surveys have emphasised that wood availability forecasts are the most used and valued product delivered under the NEFD programme. The previous regional and national forecasts were prepared between 2006 and 2010 and are available here: http://www.mpi.govt.nz/news-resources/publications.aspx?title=Forest%20Industry%20and%20Wood%20Availability%20Forecasts

MPI's publication, *Otago/Southland Forest Industry and Wood Availability Forecasts 2008*, is being revised and will incorporate these new forecasts. Tables providing annual harvest volumes for each scenario will be included in the appendix of this publication, and will also be available on the Ministry's website.

MPI wishes to express its appreciation to the forest owners, managers and consultants of Otago and Southland for their support in preparing these wood availability forecasts. The work would not be possible without this assistance.

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PREFACE

This report was prepared at the request of the Ministry for Primary Industries (the Client) by Indufor Asia Pacific Limited.

The project involved development of a series of regional and national wood availability forecasts for New Zealand's plantation estate.

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

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DISCLAIMER

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1. INTRODUCTION

This report presents the findings from a 2014 wood availability study of the Otago and Southland planted forest estate based on the MPI National Exotic Forest Description as at 1 April 2013. The study was undertaken by MPI, in association with the major plantation owners. The modelling supporting the study was undertaken by Indufor Asia Pacific Limited (Indufor).

Indufor prepared four production scenarios for radiata pine potential wood availability, one for Douglas-fir availability and one which combined radiata pine and Douglas-fir. The scenarios indicate how the maturing forest resource in Otago and Southland could be harvested over the 2014 to 2050 period. The scenarios are based on the available resource in each region and a series of forecasting assumptions. Only radiata pine and Douglas-fir are included in the scenarios and wood availability forecasts. There are areas of other species, including significant eucalyptus plantations in the Otago/Southland region, but these are not included in the availability forecasts.

The forecasts incorporate the harvesting intentions of the region's large-scale forest owners (those with 1000 hectares (ha) of forest or more). There was also consultation with forest managers and consultants to ensure the scenarios represented a realistic range of future wood availability.

The scenarios clearly show there are different ways for the forest resource to be harvested. In examining the scenarios, it is important to recognise that forests are normally managed in a way that maximises the benefits to the enterprise that owns them. Each enterprise has its own harvesting strategy based on the owners' objectives and market conditions. Any change in harvesting strategies by forest owners affects the age-structure and maturity of the forests it owns. This in turn feeds back into future wood availability.

A key issue is the timing of harvesting by small-scale forest owners of their forests or woodlots. The harvest age can vary markedly, even between neighbouring properties. The timing of the harvest of these forests is driven by a range of factors, including individual forest owners' objectives, forest age, log prices, demand by local wood processing plants, and perceptions about future log prices and future wood supply.

There are different levels of uncertainty associated with the wood availability from each component of the estate. While the volumes forecast from larger forest owners are subject to alteration because of changes in harvesting intentions or changes in the resource description (for example, areas and yields), a higher level of confidence can generally be assumed for these forecasts than for the small-scale owner's estate. Not only are harvest intentions less clear for small-scale owners, the resource description is potentially less accurate.

2. SCENARIOS

Four wood availability scenarios have been modelled for radiata pine. These scenarios show the range of potential ways the forests in the region could be harvested in the future.

The scenarios were developed by the National Exotic Forest Description (NEFD) Steering Committee. Indufor undertook initial modelling of the scenarios, and these were presented to the major forest owners and consultants in the Otago/Southland wood supply region. Their feedback was taken into account in the final derived profiles.

There are around 20 000 ha of species other than radiata pine and Douglas-fir in the Otago/Southland region, including 12 300 ha of short rotation eucalyptus. The volumes from these species are not included in the wood availability forecasts.

2.1 Scenario 1: Large-scale Owners Harvest at Stated Intentions, Small-scale Owners Harvest at Age 28

Large-scale owners' wood availability is based on stated harvest intentions for the period 2014 to 2023 (calendar year estimates). After 2023, a modelling assumption is that the wood availability from large-scale owners will not decrease.

Small-scale owners are assumed to harvest their forest holdings at age 28.

This is similar to scenario 2 in the 2006/07 Wood Availability Forecasts, although the target rotation age for small scale owners was 30 years in the earlier analysis.

2.2 Scenario 2: Non-declining Yield (NDY) – Target Rotation 28 years

Large-scale owners' wood availability is assumed to be at stated harvest intentions for the period 2014 to 2023. After 2023, the wood availability from large-scale owners is assumed not to decrease (as for scenario 1). The total wood availability of radiata pine from the region is modelled to be non-declining in perpetuity with a target rotation age of 28 years (30 years in scenario 3 in the 2006/07 Wood Availability Forecasts).

2.3 Scenario 3: Split NDY – Target Rotation 28 years

This is the same as scenario 2 except that the total wood availability of radiata pine from the region is allowed to decline after 2034 for a period of five years. Over this five year period, an annual change of up to 10% is allowed. The yield is then required to be non-declining from 2039.

2.4 Scenario 4: Target Rotation Age Variations

This is similar to scenario 3 except that target rotation ages of 26 and 30 years are also modelled (28 and 32 years in the 2006/07 Wood Availability Forecasts).

2.5 Discussion of the Scenarios - Radiata Pine

Figure 2-1A to Figure 2-1C illustrate the differences between Scenarios 1 to 3 (respectively) using the Otago radiata pine resource as an example (more detailed discussion is provided in Section 4).

In scenario 1 (Figure 2-1A), the forests owned by small-scale owners are assumed to be harvested at age 28. The scenario shows the "potential" availability of mature forest from small owners in any given year. This scenario directly reflects the area of forest in the small ownership category in each age-class in the Otago region. For practical reasons already described, it is unlikely that the future harvesting would occur this way. The intention of this scenario is to show the potential magnitude of harvesting under favourable market conditions in any given year.

Scenarios 2 and 3 (Figure 2-1B and Figure 2-1C, respectively) are based on yield regulation. Yield regulation refers to where, when, and how these recoverable volumes should be extracted, and provides a more orderly harvesting volume profile that, to some degree, reflects logistical and market constraints. Under these scenarios, the future harvesting model is generally constrained to be non-declining: that is, each year the volume must either be the same or higher than in the previous year.

Scenarios 2 and 3 avoid the large year-to-year fluctuations in volume seen in scenario 1. A fundamental property of the forests in Otago (like many regions in New Zealand) is the large area of forests established during the 1990s. Scenarios 3 and 4 illustrate the harvesting of these forests by applying a non-declining yield constraint for the period 2014 to 2034. Then once the "bulge" of forest area planted during the 1990s has been harvested, the model lets the volume decline again.

The main limitations of scenarios 2 to 4 are that log prices and other market factors are a significant determinant of harvesting in any given year. When log prices go up, harvesting will generally increase. When log prices fall, the level of harvesting will generally decrease. It is beyond the scope of this analysis to predict future log prices.

2.6 Scenario for Douglas-fir

One scenario is presented for Douglas-fir (all owners). It is based on the harvest intentions of large-scale owners for 2014 to 2023 with the yield regulated in subsequent years. After 2023, the wood availability from large-scale owners from large-scale owners is modelled in a five-year period non-declining yield (NDY) block (i.e. 2024-2028, 2029-2033, etc). The total wood availability of the combined estate is also modelled to be non-declining within each of the five-year period NDY blocks. The harvest level for the first five-year NDY block is set to be the same as in 2023. The total wood availability from clearfell and production thinning operations can change by 100 000 m^3 per year for the large-scale owners' estate and by 150 000 m^3 per year for the combined estate. The target rotation age is 40 years for Douglas-fir (45 years was used in the 2006/07 forecasts).

2.7 Combined Douglas-fir & Radiata Pine Scenario

Following consultation with forest owners and other stakeholders in the region, a further scenario was developed where potential wood availability from Douglas-fir and radiata pine was modelled jointly. Feedback from major owners suggested that combining both species was normally considered when undertaking harvest planning in the region. Assumptions made in this scenario included:

- The large scale resources are harvested at stated intentions (for both Douglas-fir and radiata pine).
- The total wood availability from both species is constrained to be non-declining in perpetuity.
- Target rotation ages of 28 years for radiata pine and 40 years for Douglas-fir.
- After 2023 the large-scale Douglas-fir resources are modelled in a five-year period NDY block.
- Total wood availability from clearfell and production thinning operations of Douglas-fir can change by 100 000 m^3 per year for the large-scale owners' estate and by 150 000 m^3 per year for each region.

Illustration of Wood Availability Scenarios (Otago Radiata Pine Forecasts)

Figure 2-1A: Scenario 1: Large-scale Owners Harvest at Stated Intentions, Small-Scale Owners Harvest at Age 28

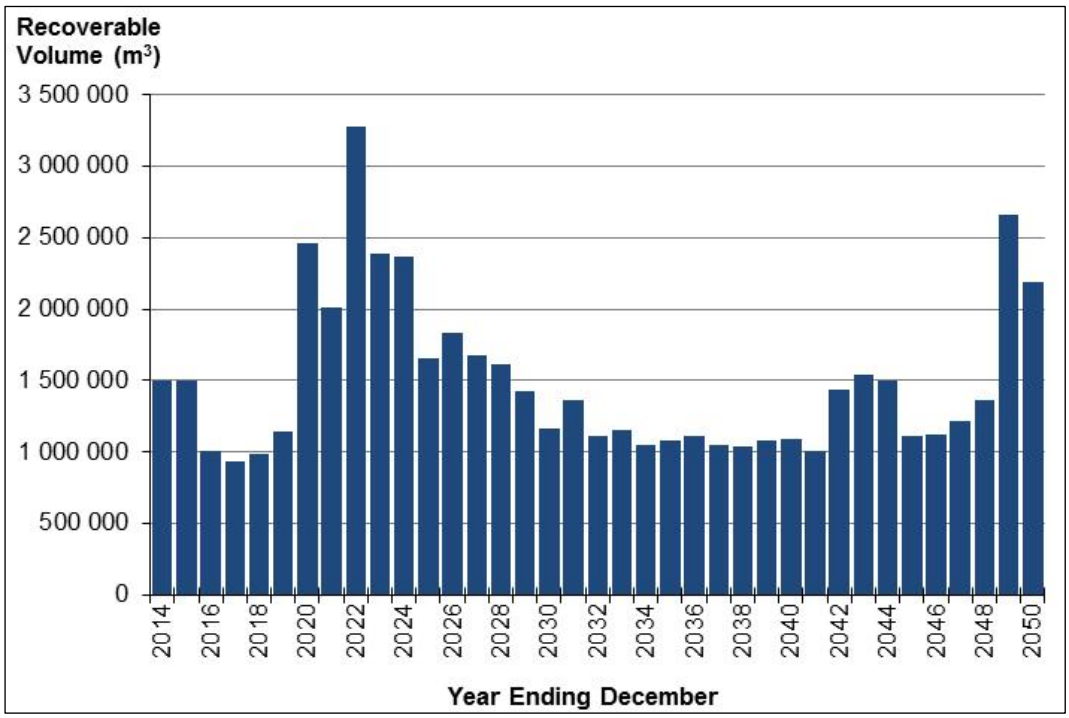


Figure 2-1B: Scenario 2: Large-Scale Owners Harvest at Stated Intentions. Overall Non-Declining Yield with a Target Rotation of 28 Years

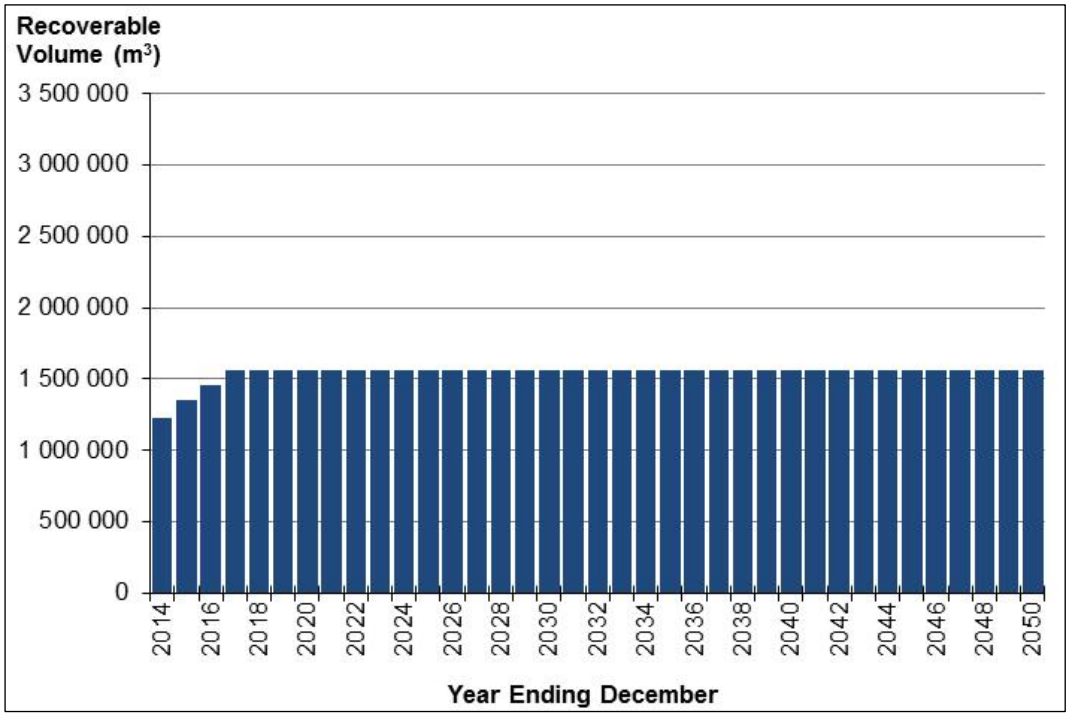
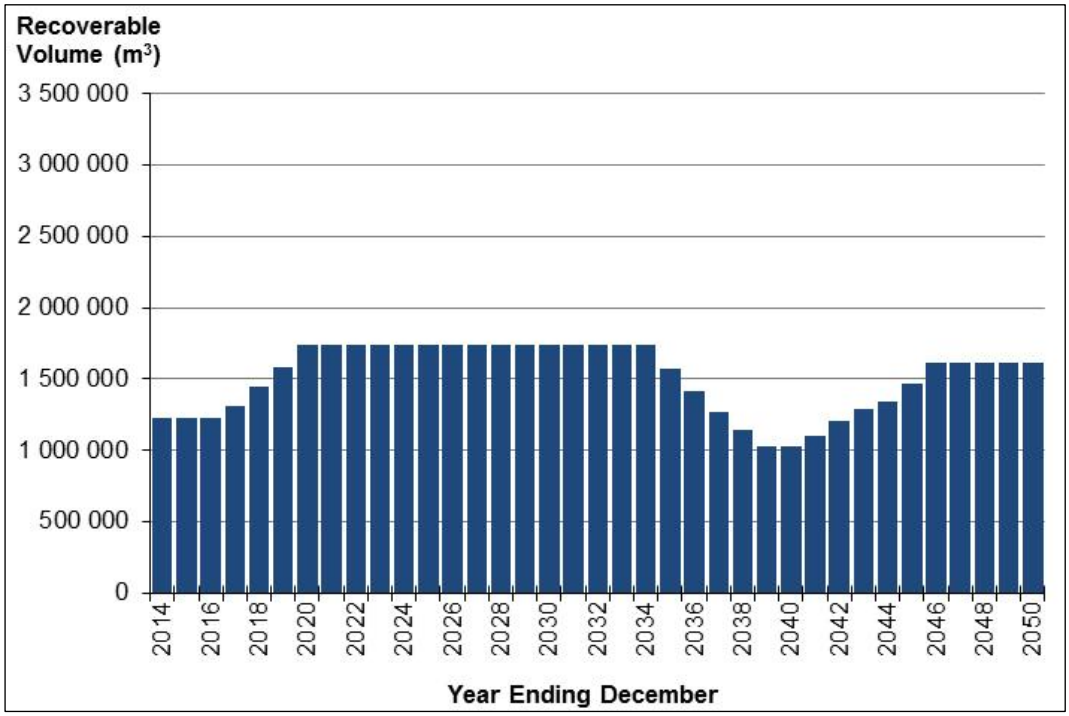


Figure 2-1C: Scenario 3: Large-scale Owners Harvest at Stated Intentions. Overall Split Non-Declining Yield with Target Rotation of 28 Years



3. DATA

3.1 Method Used to Obtain Forest Areas

The forest areas were sourced from A National Exotic Forest Description as at 1 April 2013 (MPI 2013). The area for the large-scale owners was unadjusted, while the area for the small-scale owners' estate was reduced by 15%.

This adjustment was made as small-scale owners generally report on a gross area basis rather than net stocked areas (excluding unplanted areas, areas not successfully established, streams, roads and wetlands).

In addition to this, reductions were made to the area of over-mature stands. For large-scale owners, areas older than 35 years of age were considered non-commercial and excluded. For small-scale owners, the maximum age was 40 years.

3.2 Method Used to Develop Yield Tables

In 2006, new yield tables for Otago and Southland were developed in the following way:

- Large-scale forest owners provided yield tables for their forest estates.
- These tables were averaged on an area-weighted basis to derive regional yield tables for each crop-type.
- The area-weighted average regional yield tables for "old" radiata pine (planted before 1989), and Douglas-fir were then calibrated to match the harvest intentions data provided by large-scale owners. The assumption is that the harvest intentions data is the most accurate information available, as it is based predominantly on detailed inventory.
- The area-weighted average regional yield tables for "young" radiata pine crop-types (planted in 1990 and later) were also adjusted based on consultation with large-scale owners.
- The area-weighted average regional yield tables developed for the large-scale owners' estate were also applied to the small-scale forest owners' estate.

For these forecasts the yield tables developed in 2006 were utilised, but were again calibrated to the harvest intentions information provided by large forest owners (essentially the process described in the third bullet point above was redone to derive yield tables that reflected yields expected by the large owners).

The production thinning yield tables for Douglas-fir were derived from the large-scale owners harvest intention survey conducted in 2014.

3.3 Large-Scale Owners' Harvest Intentions

Large-scale owners were asked to provide details of their projected harvest volumes (by log grade, area and average harvest age) for the 2014 to 2033 period. The 15 largest owners all provided yearly (31 December) summary data for the project. Inclusion of actual levels of intended harvest by the large owners is considered a critical step, as it provides the best estimate of future wood availability for the first ten years (2014-2023) of the forecast horizon.

4. WOOD AVAILABILITY FORECASTS FOR OTAGO

4.1 Otago Region

The Otago region has a plantation resource of 123 400 ha, spread across five territorial authorities – Central Otago, Clutha, Dunedin City, Queenstown-Lakes and Waitaki. The majority of the resource is concentrated in the Clutha District, with 82 200 ha (as at 1 April 2013).

4.2 Assumptions

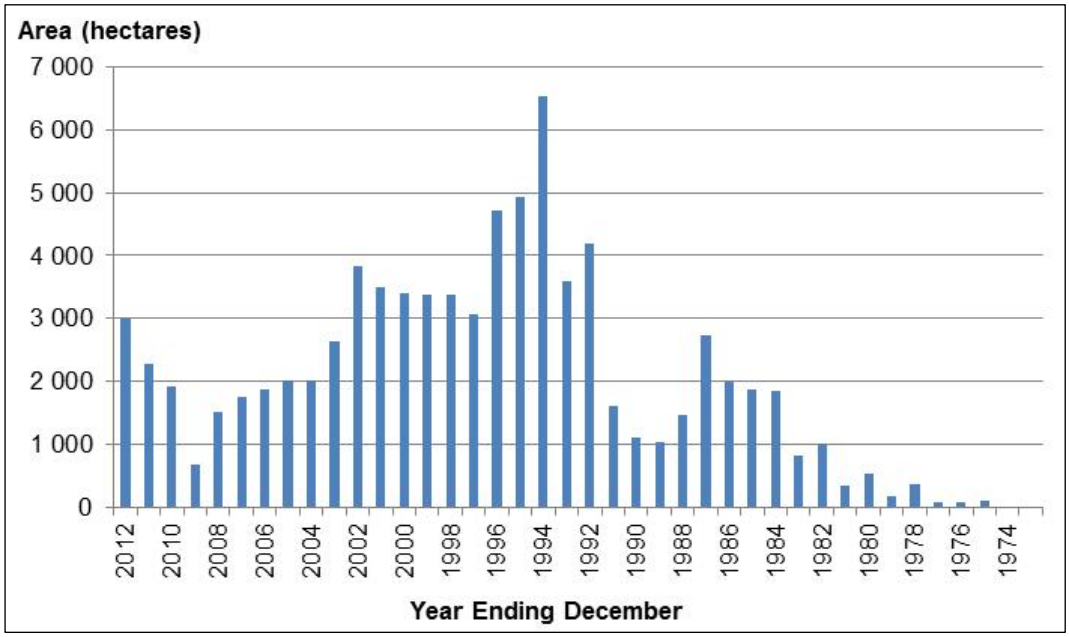
The wood availability forecasts for Otago are based on the following assumptions:

- All areas are replanted, with a regeneration lag of one year. Replanting is as follows:
  - Large-scale forest owners: all areas are planted back into the same species apart from about 5 500 ha of radiata pine that is replanted into Douglas-fir
  - Large-scale forest owners: 40% of all pruned areas will be replanted as a pruned regime with 60% transferring to an unpruned regime
  - Small-scale forest owners: all areas are planted back into the same species
  - Small-scale forest owners: 70% of all pruned areas will be replanted as a pruned regime with 30% transferring to an unpruned regime
- Based on discussions with major forest owners and consultants in the region, it was determined that conversion of forests to other land uses was not being undertaken at a sufficient rate for it to be incorporated into the wood availability forecasts.
- The area awaiting replanting as at 31 March 2013 is included as area at age 0 (that is, the area to be replanted in the 2013 planting season).
- Small-scale owner areas awaiting replanting as at 31 March 2012 are assumed to have been replanted in 2012 (small owners are only surveyed every second year for the NEFD).
- Total roundwood removals in the Otago/Southland region were estimated to be 2.05 million m^3 for the year ended 31 March 2013, of which total radiata pine and Douglas-fir removals were estimated to be 1.86 million m^3. This was used to derive the harvest level for the first year of the model.
- Radiata pine areas in the large-scale owners' estate aged over 35 years is assumed to be non-commercial and therefore will not be harvested.
- Radiata pine areas in the small-scale owners' estate aged over 40 years is assumed to be non-commercial and therefore will not be harvested.

4.3 Scenario 1

In this scenario, large-scale owners harvest in line with their stated intentions and small-scale owners harvest their forests at age 28. Figure 4-1 shows the age-class distribution for the Otago radiata pine estate for both large and small-scale owners combined.

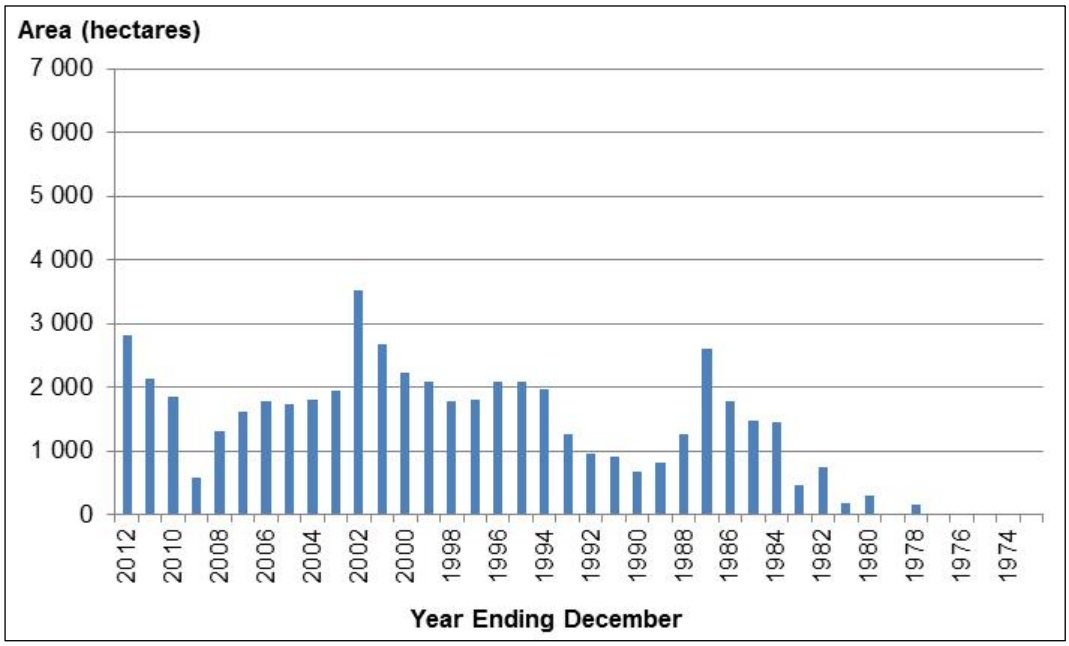
Figure 4-1: Otago Age-class Distribution of Radiata Pine – All Owners Estate as at 1 April 2013



4.3.1 Large-scale Owners' Estate

The age-class distribution of the large-scale owners' estate (Figure 4-2) shows there is about 2 000 ha in most age-classes up to age 20. From ages 20 to 30 there is an average of approximately 1 200 ha in each age-class. In addition, a total of 4 091 ha of large-scale owner bare land is awaiting replanting.

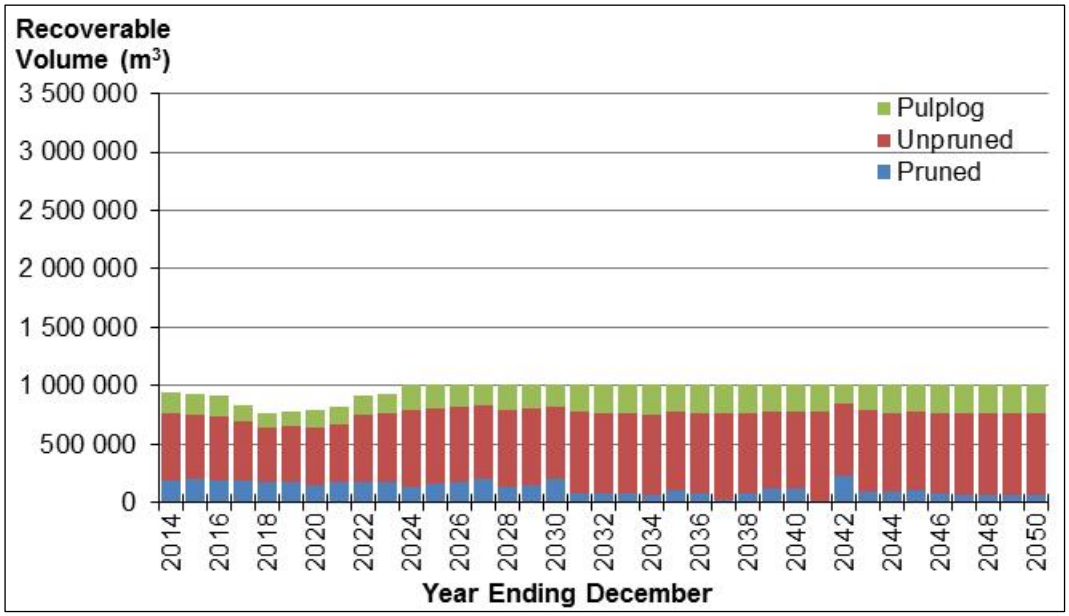
Figure 4-2: Otago Age-class Distribution of Radiata Pine – Large-Scale Owners as at 1 April 2013



For this scenario, the availability of wood from large-scale owners is based on their stated harvest intentions for 2014 to 2023. Thereafter the availability is constrained to be non-declining with a target rotation age of 28 years. The wood availability of large-scale owners

(Figure 4-3) is forecast to be relatively static through the forecast period. Although there is replanting of some radiata pine area into Douglas-fir, the volume of radiata pine can be sustained.

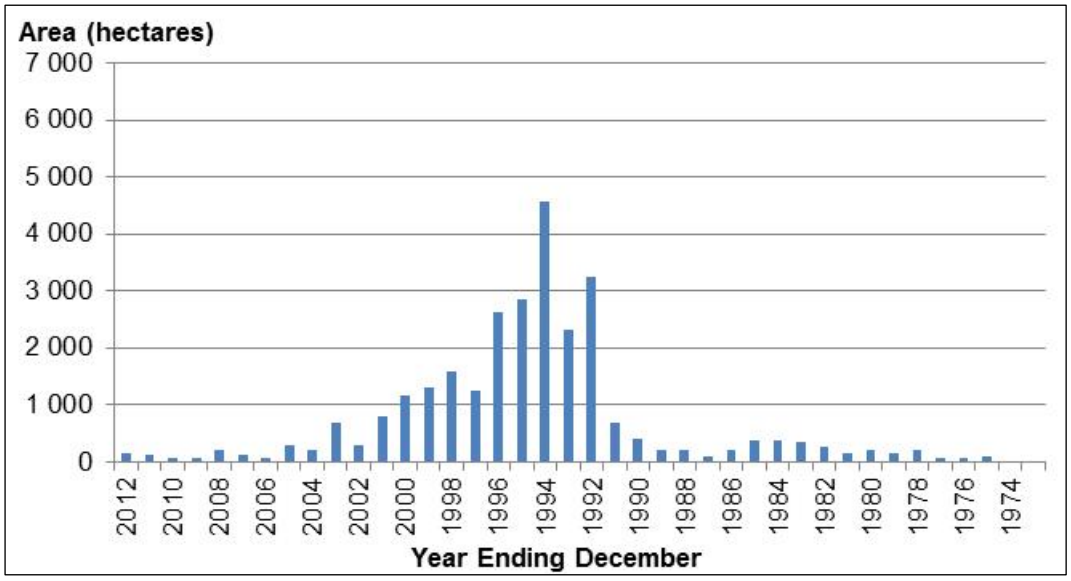
Figure 4-3: Otago Radiata Pine Availability under Scenario 1 – Large-Scale Owners



4.3.2 Small-Scale Owners' Estate

The age-class distribution of the small-scale owners' estate (Figure 4-4) is very irregular, with more than 2 000 ha planted each year between 1992 and 1996 (currently 17 to 21 years old) and much less area in all other age-classes. The wood availability from this estate is significantly influenced by the timing of the harvest of the large area aged 17 to 21.

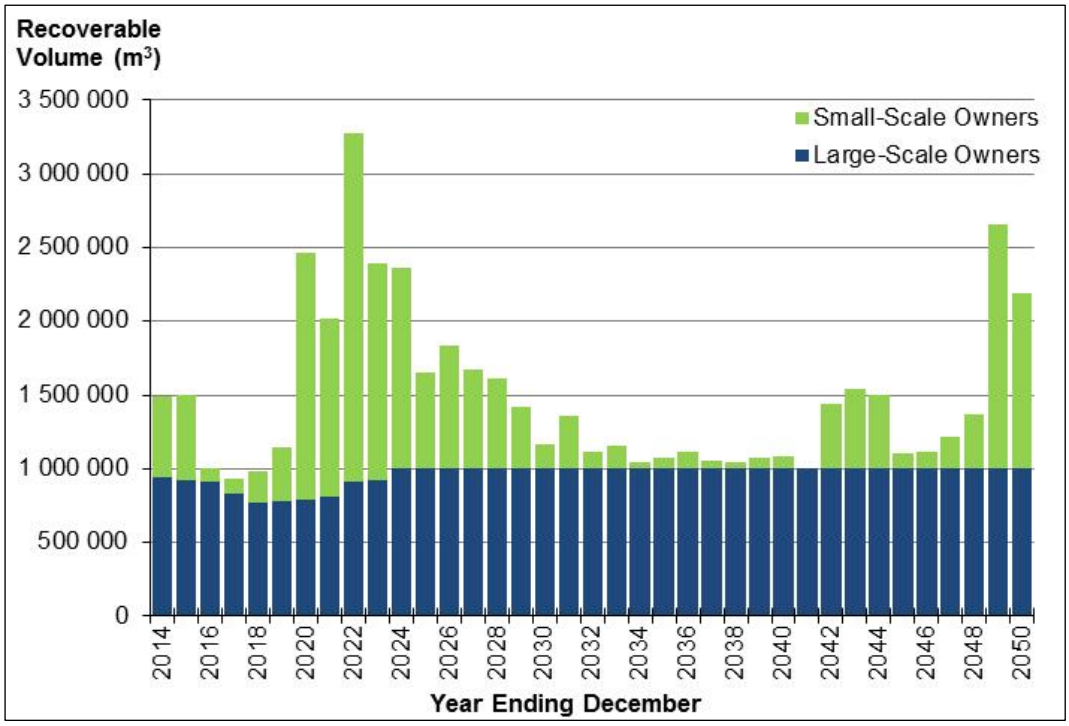
Figure 4-4: Otago Age-class Distribution of Radiata Pine – Small-Scale Owners as at 1 April 2013



4.3.3 Wood Availability from the Combined Estate for Scenario 1

The wood availability from all owners in Otago is presented in Figure 4-5. The large-scale owners' resource is shown as the "base" volume, and the forecasts match the volumes in Figure 4-3. The fluctuation in the total annual forecast volumes reflects the variation in the areas in each age-class of the small-scale owners' estate, and the assumption that this estate is harvested at age 28.

Figure 4-5: Otago Radiata Pine Availability under Scenario 1 – All Owners



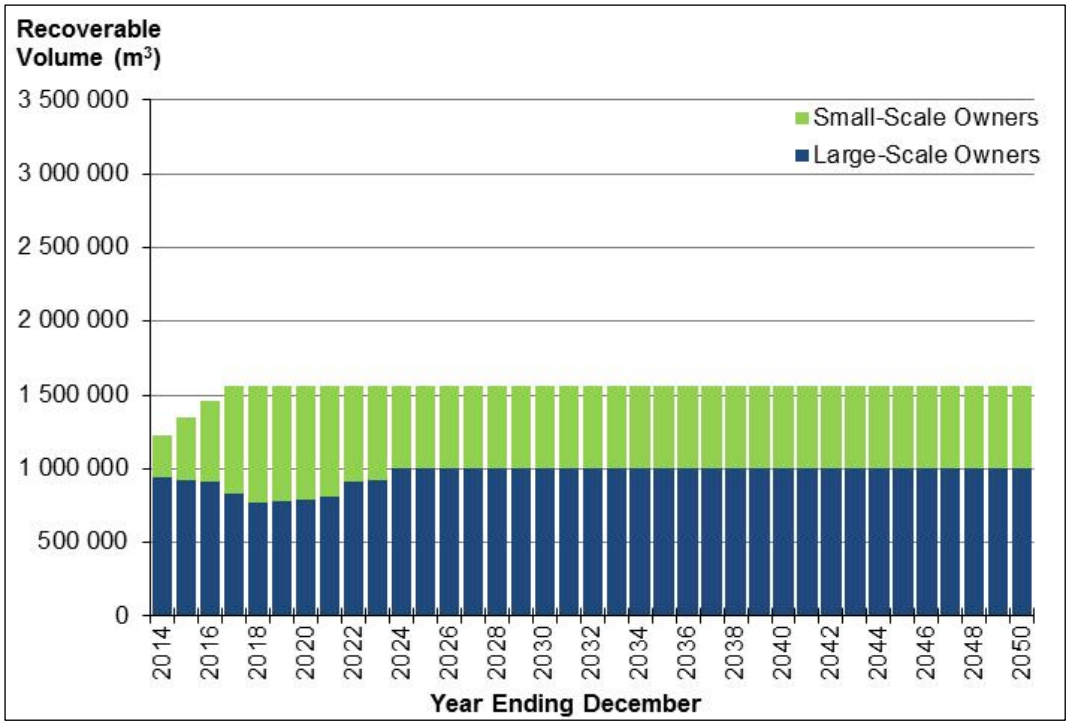
The large increase in harvest volume after 2019 (Figure 4-5) reflects the maturing of the small-scale owners' estate. For example, the increase in 2020 is a consequence of the 3 240 ha planted by small-scale owners in 1992 (Figure 4-4) being harvested at age 28 years.

Fluctuations in harvest volumes of the magnitude shown in Figure 4-5 would be impractical due to operational constraints (for example: availability of harvest machinery, harvesting crews and transport operators) and market absorption constraints (for example: limited domestic wood processing capacity, levels of export demand).

4.4 Scenario 2

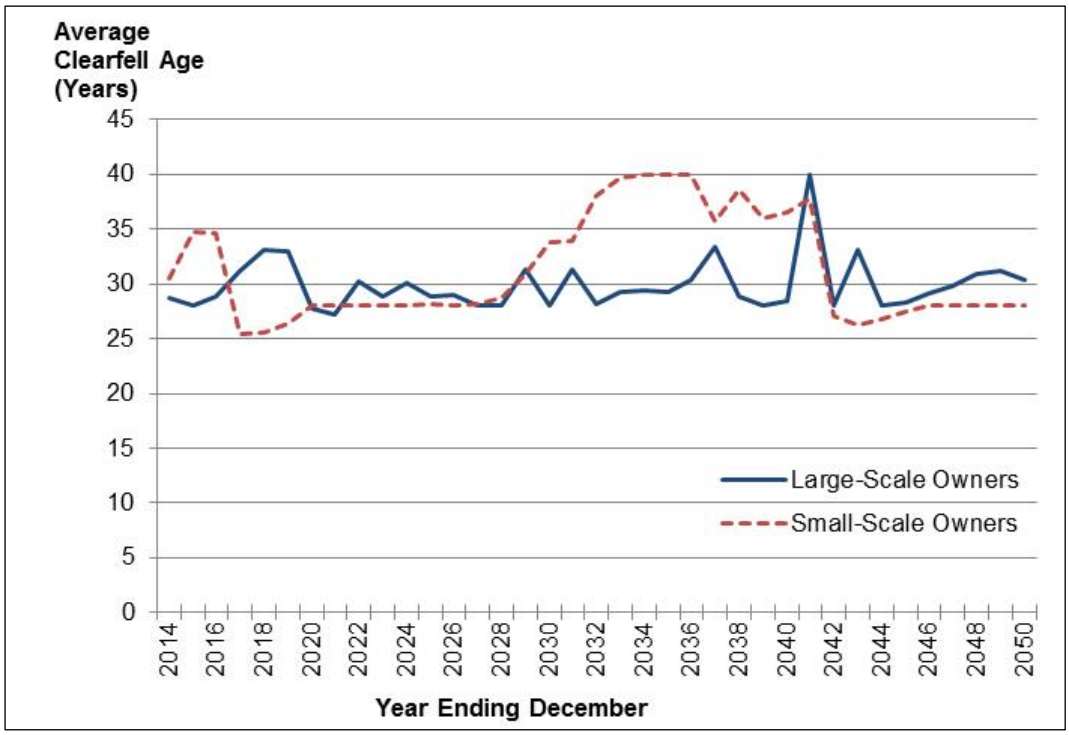
The second scenario assumes large-scale owners' resources are harvested as per their harvest intentions for the first 10 years, then a non-declining yield constraint is applied to the large-scale owners' estate after 2023. In addition, a non-declining yield constraint is applied to the total overall radiata pine estate, with a target rotation age of 28 years. Figure 4-6 indicates that a possible increase in the small-scale owners' estate is imminent and could increase from close to 0.3 million m³ in 2014 to over 0.5 million m³ from 2017. This could potentially more than offset the planned decline in harvest levels of major forest owners over the next few years.

Figure 4-6: Otago Radiata Pine Availability under Scenario 2 – All Owners



This scenario does at times require that the harvest age varies significantly from the target rotation of 28 years. This is especially the case for small-scale forest owners (Figure 4-7).

Figure 4-7: Otago Average Radiata Pine Clearfell Age under Scenario 2 – by Ownership Category



4.5 Scenario 3

The third scenario again assumes large owners' resources are harvested in line with their harvest intentions between 2014 and 2023, and then non-declining after 2023. However, the overall yield is based on a split non-declining yield, with a target rotation age of 28 years. A drop in the overall harvest volume is allowed after 2034 for a five-year period (between 2035 and 2039 of no more than 10% per year). This scenario gives a forecast wood availability that is different to scenario 2 (Figure 4-8). Wood availability increases from 1.23 million m³ in 2014 to 1.74 million m³ in 2020, and levels out at 1.74 million m³ per year from 2020 to 2034. Harvest volumes then dip to around 1.03 million m³ per year between 2039 and 2040 before again increasing to 1.62 million m³ per year from 2046.

The main difference from scenario 2 is that the large area of young stands in the small-scale owners' estate is assumed to be harvested over a shorter period of time, although the total volume was modelled not to decrease between 2014 and 2034.

A consequence of there being more flexibility over when the small-scale owner estate is harvested is that the average clearfell age for small-scale owners stays closer to the target of 28 years than in scenario 2 (Figure 4-9).

Figure 4-8: Otago Radiata Pine Availability under Scenario 3 – All Owners

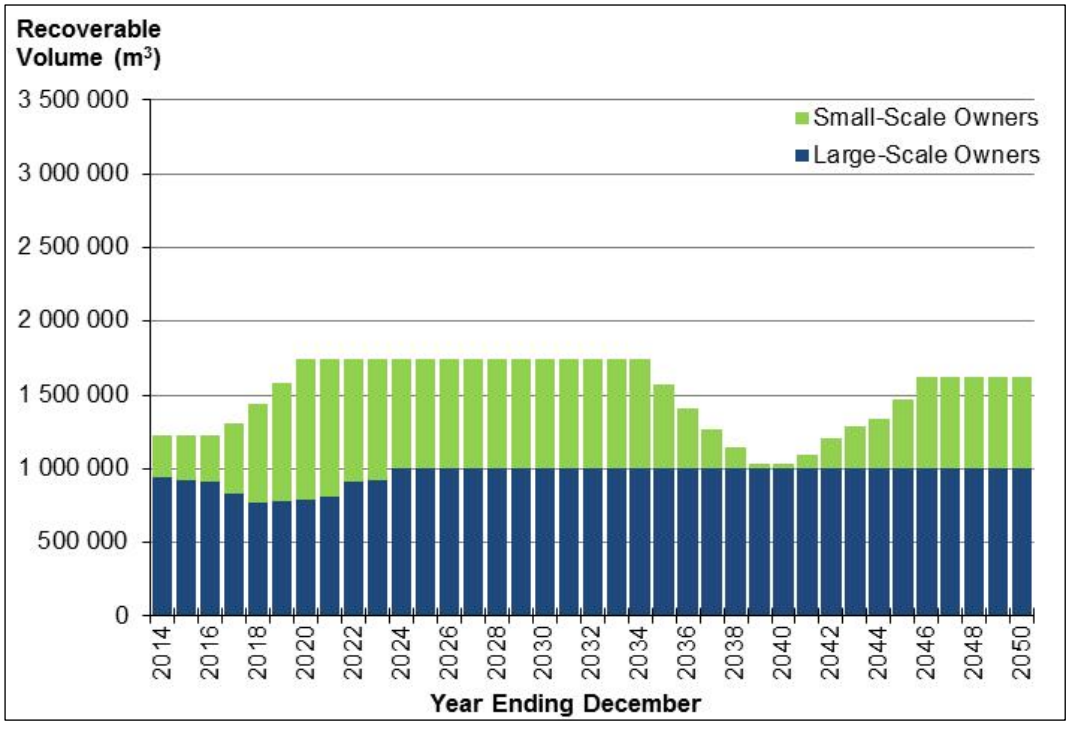
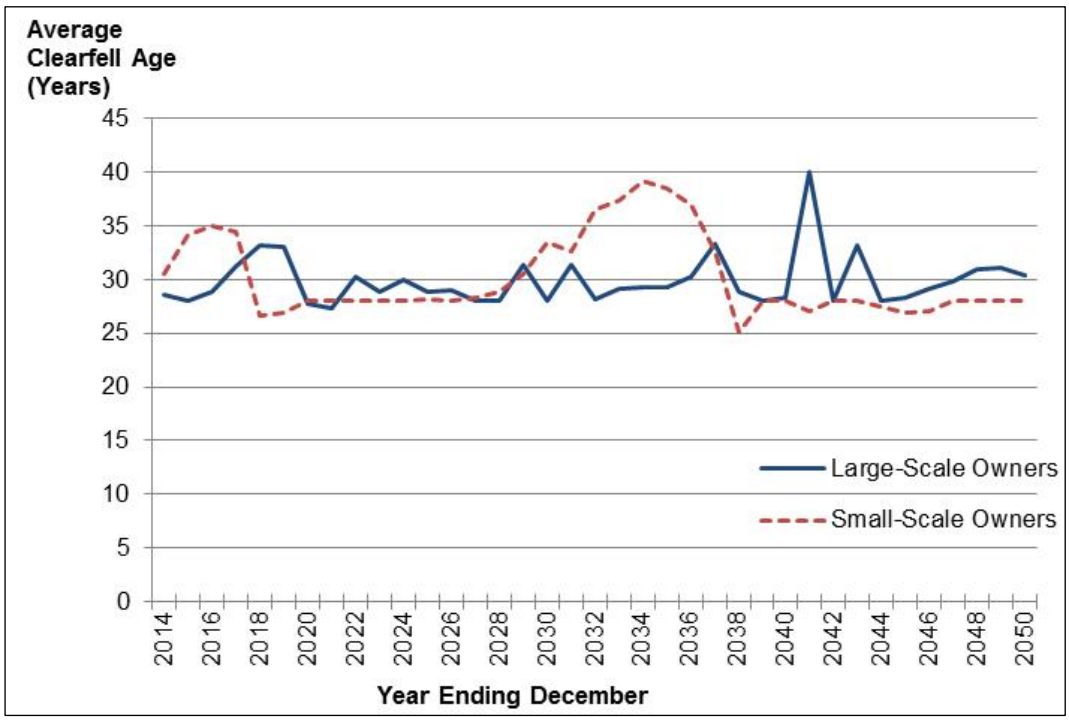
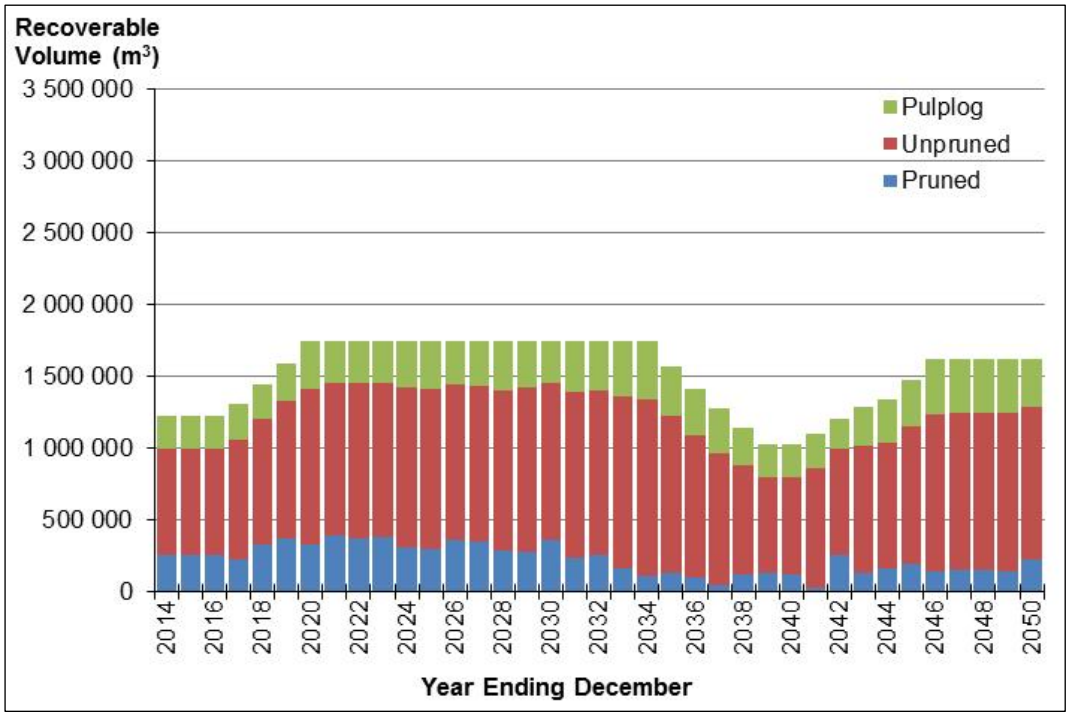


Figure 4-9: Otago Average Radiata Pine Clearfell Age under Scenario 3 – by Ownership Category



The harvest volumes forecast under scenario 3 are broken down by log grade in Figure 4-10.

Figure 4-10: Otago Radiata Pine Availability under Scenario 3 – by Log Grade (all owners)



4.6 Scenario 4

Target rotation ages of 26 or 30 years are used (rather 28 years) and the same constraints are applied as in scenario 3 (Figure 4-11).

The harvest ages are somewhat constrained for the first ten years by the large-scale owners' harvest intentions and the requirement for a non-declining yield for the large owner's estate as well as the overall radiata pine estate. These constraints are loosened somewhat for the 26 and 30 year target rotations to allow these rotation lengths to be more closely matched. Figure 4-12 still illustrates however the difficulty in achieving the desired rotation lengths within the overall harvesting constraints imposed by the scenario.

Figure 4-11: Otago Radiata Pine Availability by Target Rotation Age under Scenario 4 – All Owners

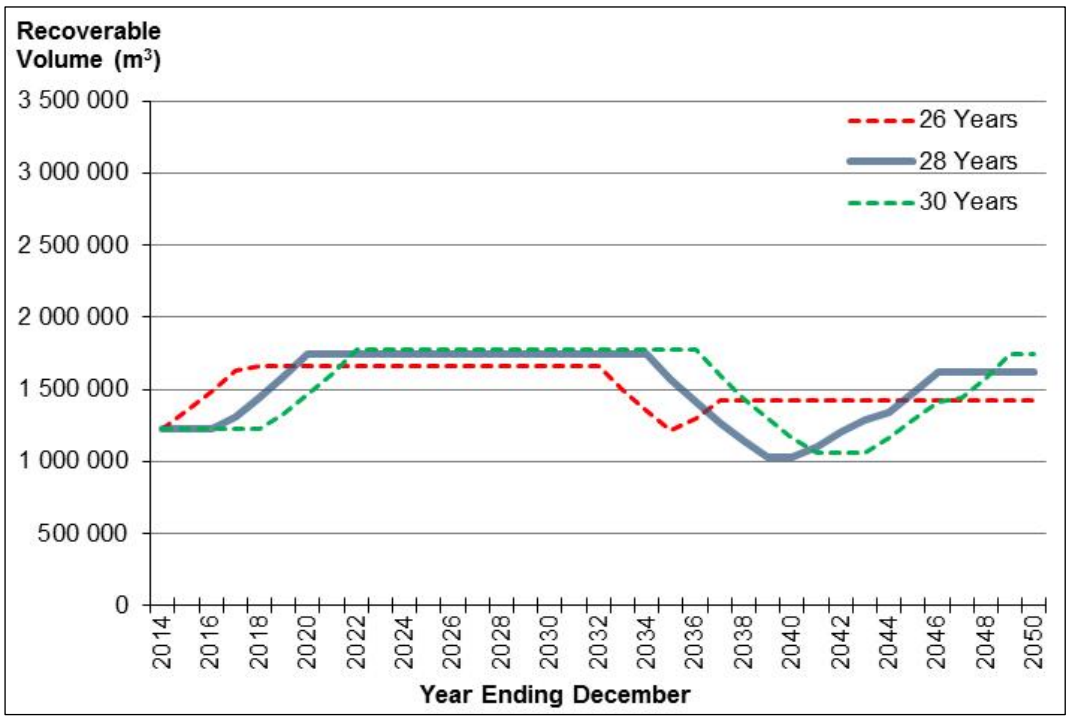
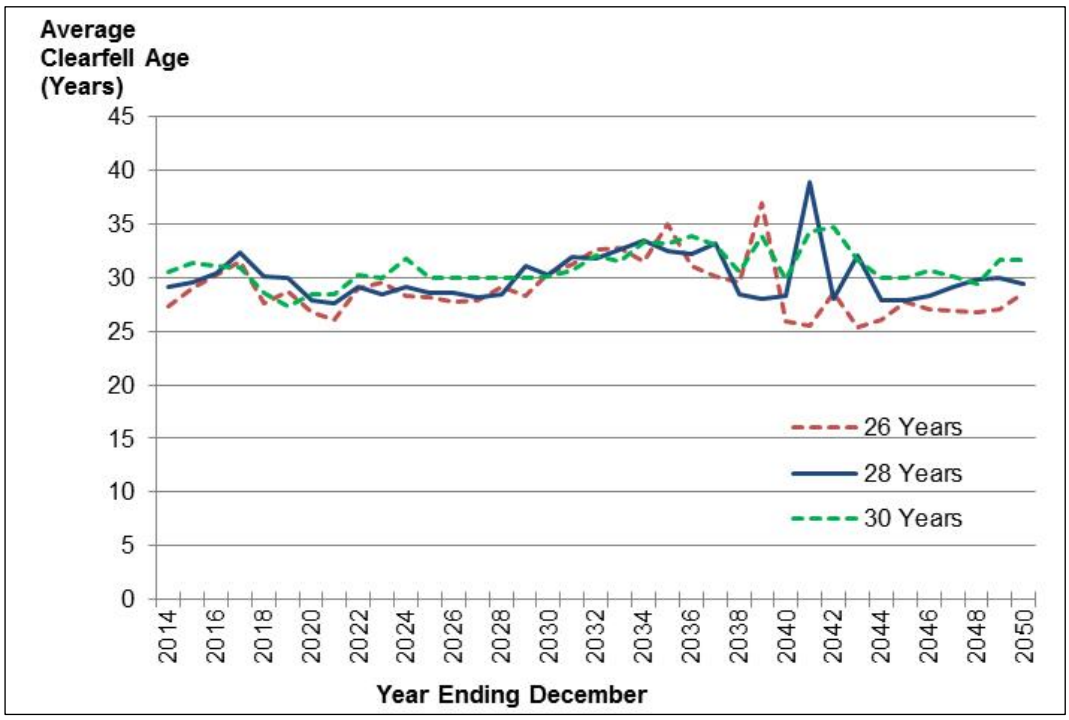


Figure 4-12: Otago Average Radiata Pine Clearfell Age by Target Rotation Age under Scenario 4 – All Owners



4.7 Douglas-fir

The age-class distribution of Douglas-fir in Otago is far from uniform, as shown in Figure 4-13. Large areas of Douglas-fir were established from 1997 and 2000 (and to a lesser extent 2003), mainly by large-scale forest owners. This imposes challenges for future yield regulation.

The Douglas-fir harvest for the large-scale owners' estate is based on intentions for 2014 to 2023. After 2023, the wood availability from large-scale owners is modelled in a five-year period non-declining yield (NDY) block (i.e. 2024-2028, 2029-2033, etc). The total wood availability of the combined estate is also modelled to be non-declining within each of the five-year period NDY blocks (Figure 4-14). The harvest level for the first five-year NDY block is set to be the same as in 2023. The wood availability of Douglas-fir from clearfell and production thinning operations can change by 100 000 m³ per year for the large-scale owners' estate and by 150 000 m³ per year for the combined estate.

The target rotation age is 40 years for Douglas-fir.

Figure 4-13: Otago Age-class Distribution of Douglas-fir – All Owners as at 1 April 2013

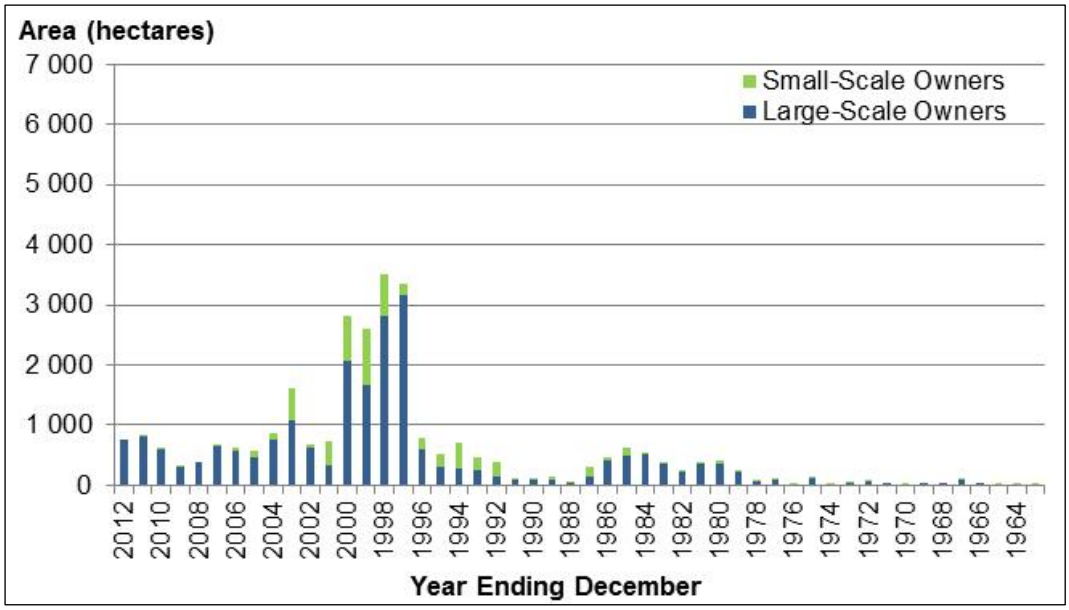
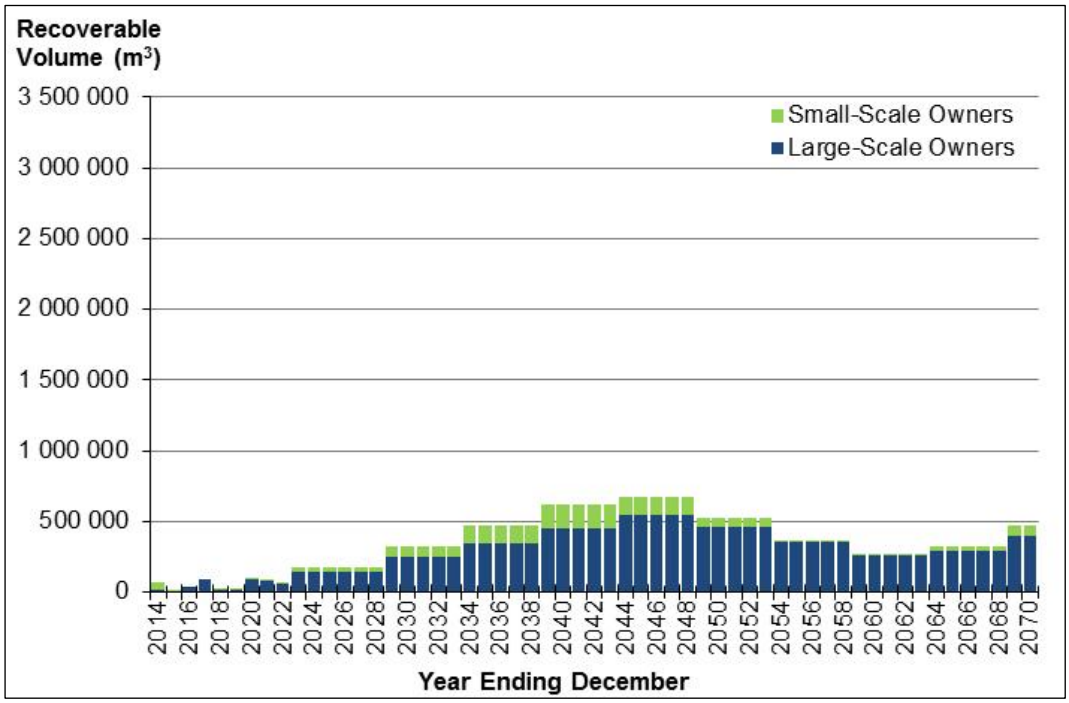


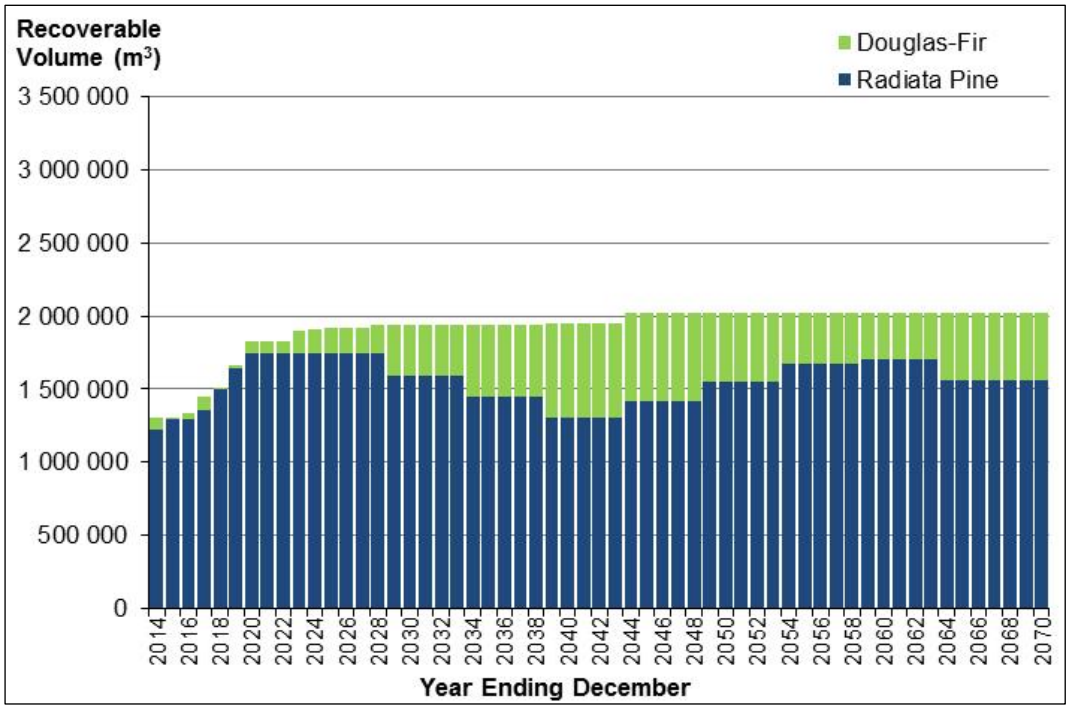
Figure 4-14: Otago Douglas-fir Availability – Combined Estate (Includes Volumes from Production Thinning as well as Clearfell)



4.8 Douglas-fir & Radiata Pine Combined

Feedback from major forest owners in the region suggested Douglas-fir was often used to fill gaps in the radiata harvest profile[1]. It was therefore recommended that radiata pine and Douglas-fir be modelled together. The radiata pine and Douglas-fir large-owner estate was harvested as per their harvest intentions for the first 10 years. This scenario is very similar to the stand alone Douglas-fir scenario in Section 4.7, except the non-declining yield constraint is modelled at a combined level for the radiata and Douglas-fir estate. Figure 4-15 shows the resulting wood availability forecasts by species. The results suggest that from 2023 a sustainable harvest of 1.90 million m³ per year is possible from the combined radiata and Douglas-fir estates, with the Douglas-fir harvest becoming more significant from 2020 onwards.

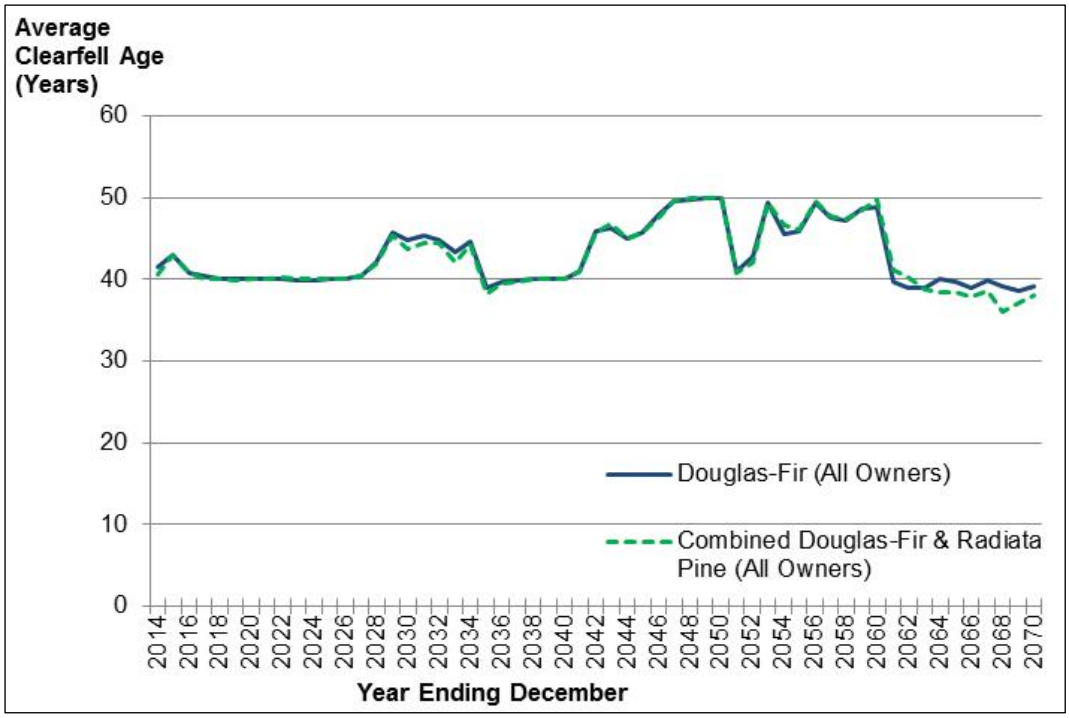
Figure 4-15: Otago Douglas-fir & Radiata Pine Combined Availability – All Owners (includes volumes from production thinning as well as clearfell)



One of the impacts of combining the radiata pine and Douglas-fir harvests is that the Douglas-fir harvest tends to be delayed to boost the total volumes once the radiata pine planted during the 1990s has been harvested. Figure 4-16 compares the rotation ages from the Douglas-fir only scenario, and the combined Douglas-fir and radiata pine scenario. It can be seen that there is little difference in terms of harvest age between the two scenarios.

[1] From an operational perspective (e.g. to maintain continuity of work-flow for harvest contractors) Douglas-fir can replace radiata pine. It is recognised, however, that if a substantial portion was to be substituted, then alternative markets may need to be developed.

Figure 4-16: Otago Average Douglas-fir Clearfell Age by Scenario – All Owners



5. WOOD AVAILABILITY FORECASTS FOR SOUTHLAND

5.1 Southland Region

The Southland region has a plantation resource of 81 800 ha, spread across three territorial authorities – Gore, Invercargill City and Southland District. The majority of the resource (94%) is concentrated in the Southland District, with 76 900 ha (as at 1 April 2013).

5.2 Assumptions

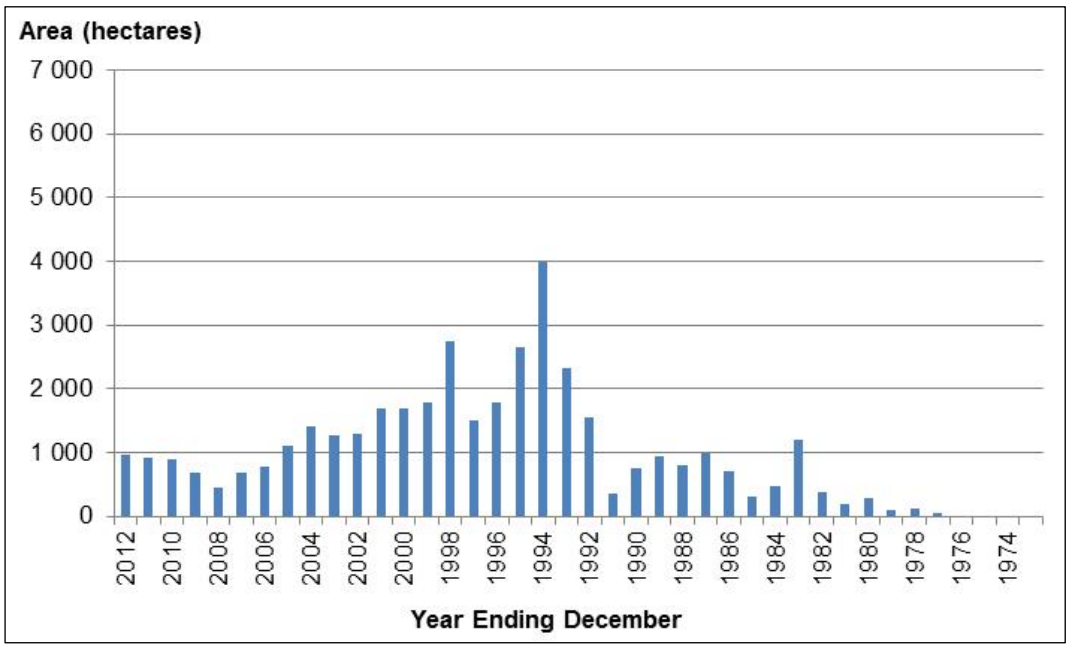
The wood availability forecasts for Southland are based on the following assumptions:

- All areas are replanted, with a regeneration lag of one year. Replanting is as follows:
  - Large-scale forest owners: all areas are planted back into the same species
  - Large-scale forest owners: 40% of all pruned areas will be replanted as a pruned regime with 60% transferring to an unpruned regime
  - Small-scale forest owners: all areas are planted back into the same species
  - Small-scale forest owners: 70% of all pruned areas will be replanted as a pruned regime with 30% transferring to an unpruned regime.
- Based on discussions with major forest owners and consultants in the region, it was determined that conversion of forestry to other land uses was not being undertaken at a sufficient rate for it to be incorporated into the wood availability forecasts.
- The area awaiting replanting as at 31 March 2013 is included as area at age 0 (that is, the area to be replanted in the 2013 planting season).
- Small-scale owner areas awaiting replanting as at 31 March 2012 are assumed to have been replanted in 2012 (small-scale owners are only surveyed every second year for the NEFD).
- Total roundwood removals in the Otago/Southland region were estimated to be 2.05 million m^3 for the year ended 31 March 2013, of which total radiata pine and Douglas-fir removals were estimated to be 1.86 million m^3. This was used to derive the harvest level for the first year of the model.
- Radiata pine areas in the large-scale owners' estate aged over 35 years is considered non-commercial and therefore would not be harvested.
- Radiata pine areas in the small-scale owners' estate aged over 40 years is considered non-commercial and therefore would not be harvested.

5.3 Scenario 1

In this scenario, large-scale owners harvest in line with their intentions, and small-scale owners harvest at age 28. Figure 5-1 shows the age-class distribution for the Southland radiata pine estate for both large and small-scale owners combined.

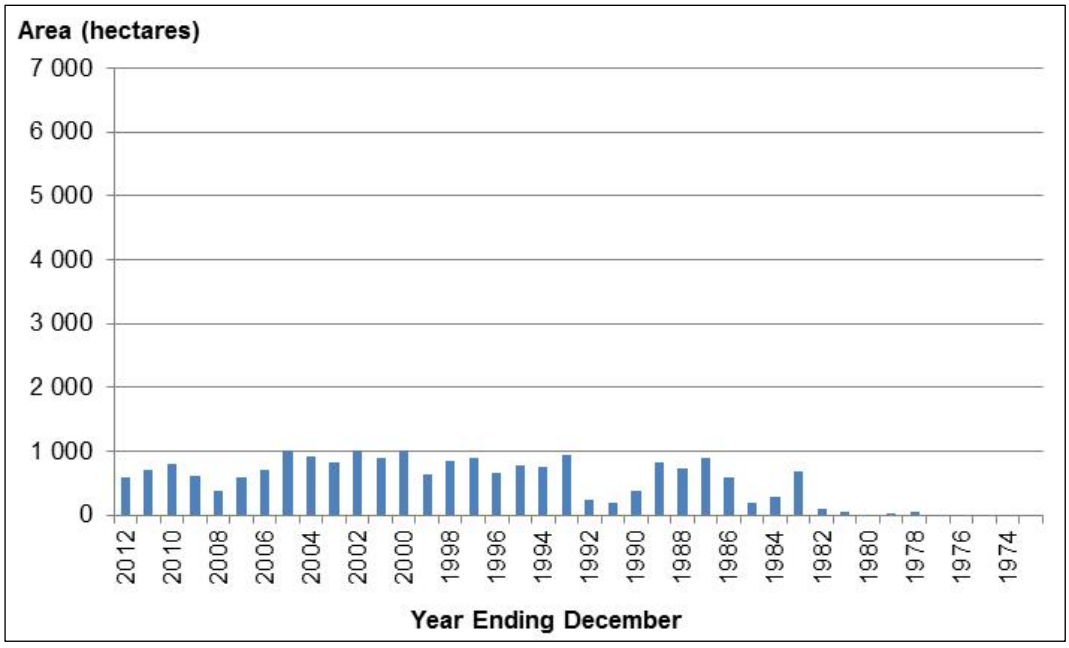
Figure 5-1: Southland Age-class Distribution of Radiata Pine – All Owners as at 1 April 2013



5.3.1 Large-scale Owners' Estate

The age-class distribution of the large-scale owners' estate (Figure 5-2) shows some variation between age-classes, a;though it is considerably more even than the total Southland estate. In addition, a total of 1 558 ha of large-scale owner bare land is awaiting replanting.

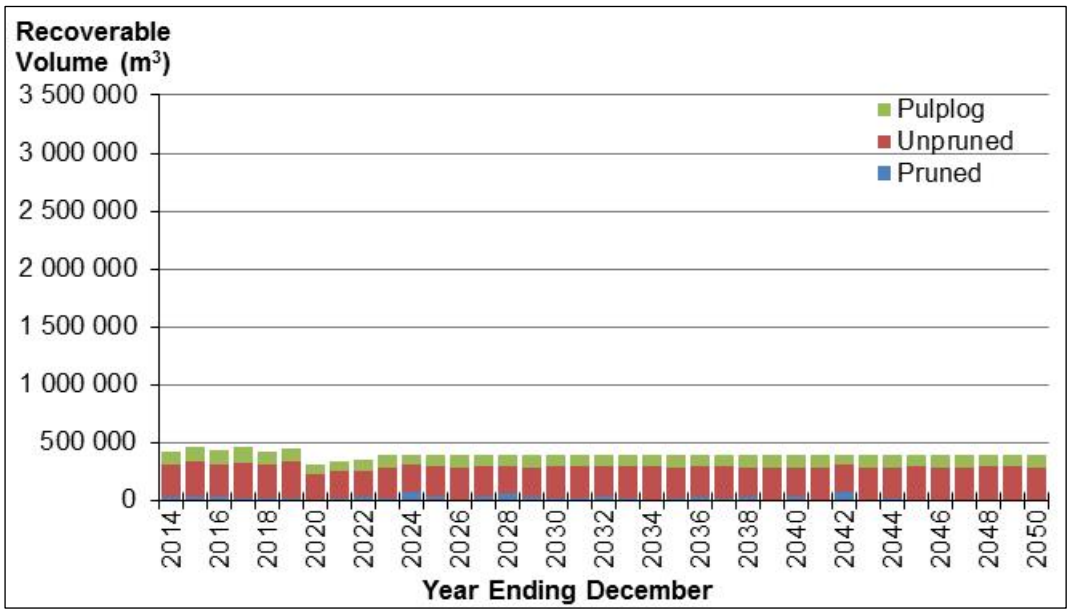
Figure 5-2: Southland Age-class Distribution of Radiata Pine Estate – Large-Scale Owners as at 1 April 2013



For this scenario, the availability of wood from large-scale owners is based on their stated harvest intentions for 2014 to 2023. Thereafter the availability is constrained to be non-declining with a target rotation age of 28 years. The wood availability of large-scale owners (Figure 5-3) is forecast to fluctuate between 419 000 m³ and 469 000 m³ per year until 2019,

before dropping to around 317 000 m³ per year in 2020. Annual harvest volumes then trend upwards until 2023, at which time they reach 389 000 m³ per year.

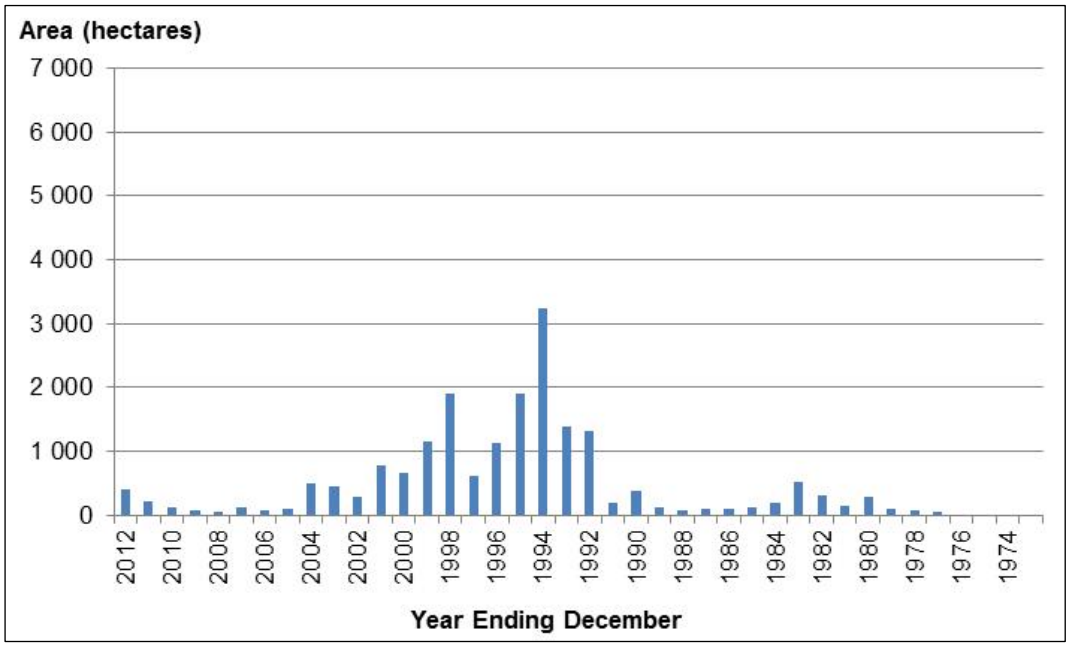
Figure 5-3: Southland Radiata Pine Availability under Scenario 1– Large-Scale Owners



5.3.2 Small-scale Owners' Estate

The age-class distribution of the small-scale owners' estate (Figure 5-4) is very irregular, with over 1 000 ha in ages 14 to 15 (planted in 1998 and 1999) and 17 to 21 years (planted in 1992 to 1996) with much less area in most other age-classes. Forecasting the wood availability from this estate will depend on the timing of harvest from the large areas in these age classes.

Figure 5-4: Southland Age-class Distribution of Radiata Pine Estate – Small-Scale Owners as at 1 April 2013



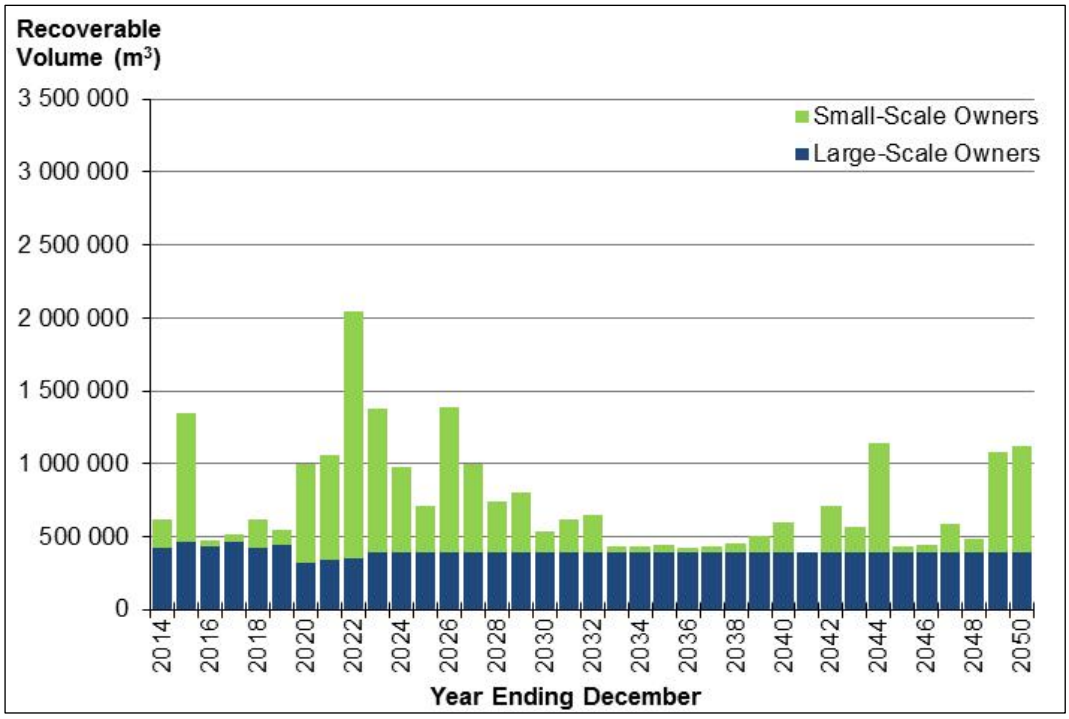
5.3.3 All Owners' Estate

The wood availability from all owners in Southland is presented in Figure 5-5. The large-scale owners' resource is shown as the base volume, and the data mirrors Figure 5-3. The fluctuation in the total volume harvested reflects the uneven age-class distribution of the small-scale owners' estate, and the assumption that this estate is harvested at age 28.

The large increase in harvest volume after 2019 (Figure 5-5) reflects the maturing small-scale owners' estate. For example, the increase in 2020 is a consequence of the 1 313 ha planted by small-scale owners in 1992 (Figure 5-4) being harvested at age 28 years. The spike in 2022 is caused by the harvest of 3 234 ha planted by small-scale owners in 1994 (Figure 5-4).

Volume fluctuations of the magnitude shown in Figure 5-5 would be impractical because of the challenges arise from harvest operation constraints (for example, limited harvest machinery, harvesting crews, and transport operators) and market constraints (for example, limited domestic wood processing facilities). There would not be enough harvesting capacity (harvesting crews and equipment) to cut all the volume available during the peak period, and it would be difficult to get short-term sales contracts to cover this volume.

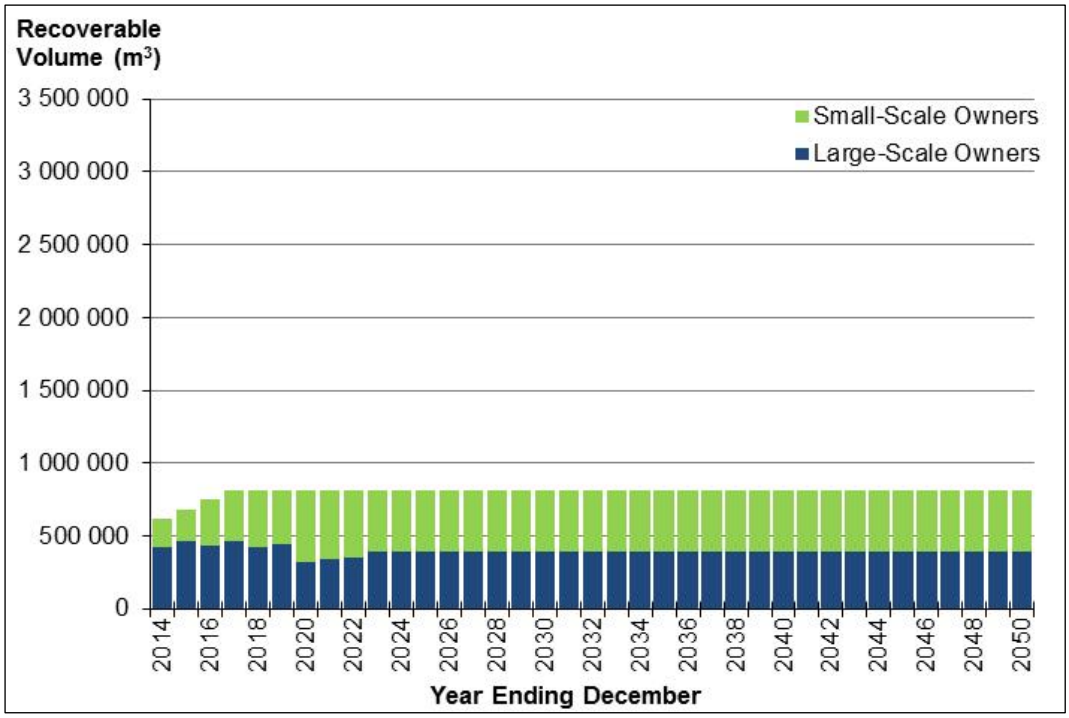
Figure 5-5: Southland Radiata Pine Availability under Scenario 1 – All Owners



5.4 Scenario 2

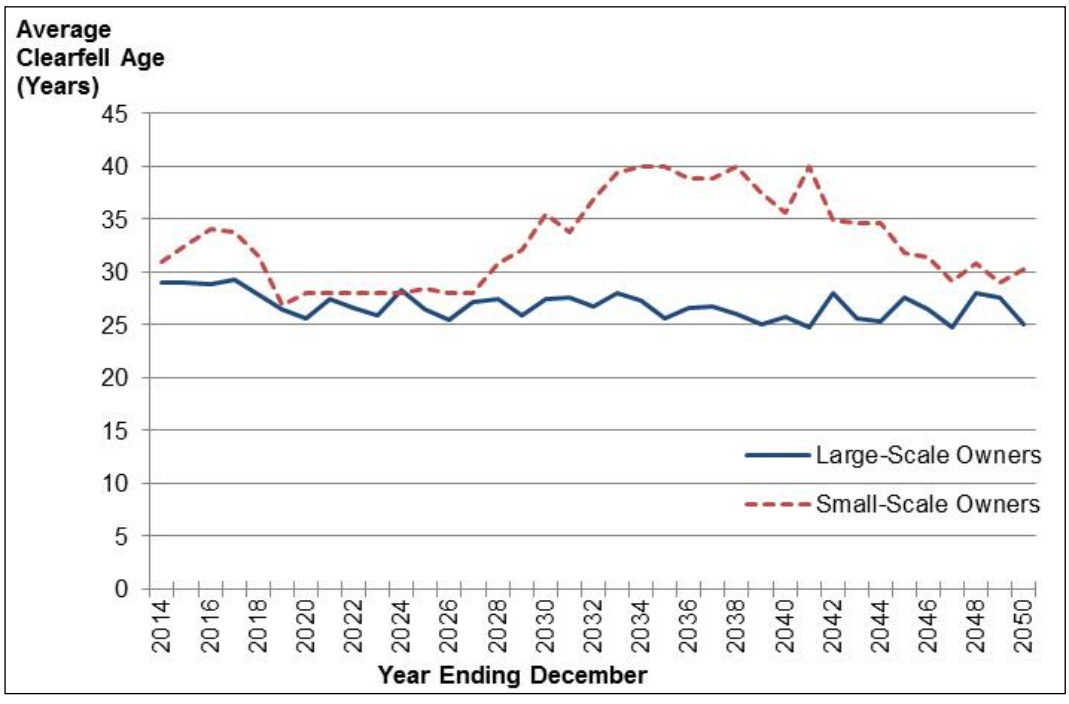
The second scenario assumes large-scale owners are harvested as per their harvest intentions for the first 10 years, then a non-declining yield constraint is applied to the large-scale owners' estate after 2023. In addition, a non-declining yield constraint is also applied to the total radiata pine volume, with a target rotation age of 28 years. Figure 5-6 indicates that an increase in the small-scale owners' estate harvest is possible and could increase to over 400 000 m³ per year by 2020.

Figure 5-6: Southland Radiata Pine Availability under Scenario 2 – All Owners



This scenario does at times require that the harvest age varies significantly from the target rotation age of 28 years. This is especially the case for small-scale forest owners (Figure 5-7).

Figure 5-7: Southland Average Radiata Pine Clearfell Age under Scenario 2 – by Ownership Category



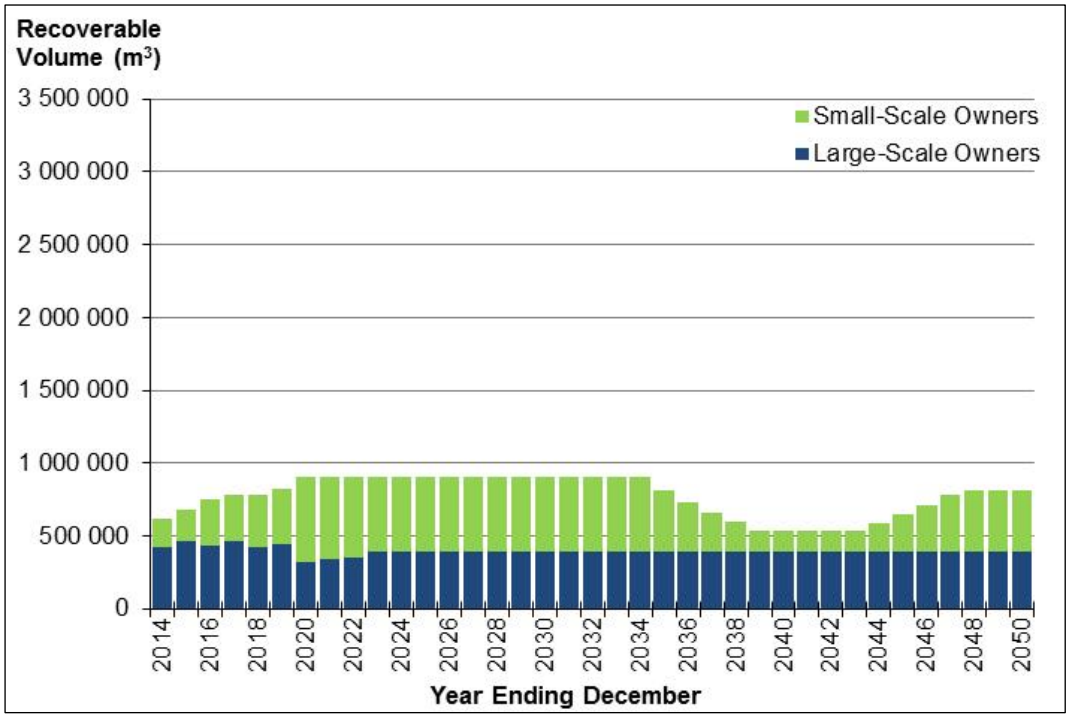
5.5 Scenario 3

The third scenario again assumes large owners' resources are harvested in line with their harvest intentions between 2014 and 2023, and then non-declining after 2023. However, the overall yield is based on a split non-declining yield, with a target rotation age of 28 years. A drop in the overall harvest volume is allowed after 2034 for a five-year period (between 2035 and 2039) (of no more than 10% per year). This scenario gives forecast wood availability that is similar to scenario 2 through to 2017 (Figure 5-8). Wood availability increases from 0.62 million m³ in 2014 to around 0.91 million m³ per year between 2020 and 2034. Harvest volumes then dip to around only 0.54 million m³ per year from 2039 to 2043 before climbing back to 0.82 million m³ per year from 2048.

The main difference from scenario 2 is that the large area of young stands in the small-scale owners' estate is assumed to be harvested over a shorter period of time, although the total volume was modelled not to decrease between 2014 and 2034.

A consequence of there being more flexibility over when the small-scale owner estate is harvested, is the average clearfell age for small-scale owners stays closer to the target of 28 years than in scenario 2 (Figure 5-10).

Figure 5-8: Southland Radiata Pine Availability under Scenario 3 – All Owners



The harvest volumes forecast under Scenario 3 are broken down by log grade in Figure 5-9.

Figure 5-9: Southland Radiata Pine Availability Under Scenario 3 – by Log Grade

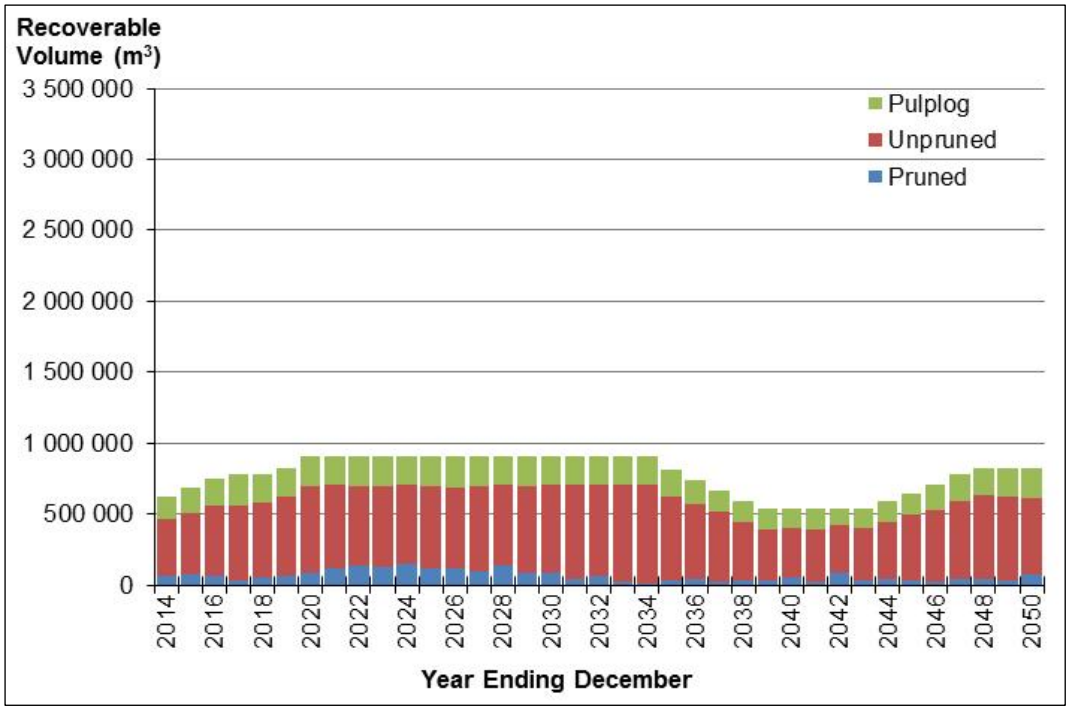
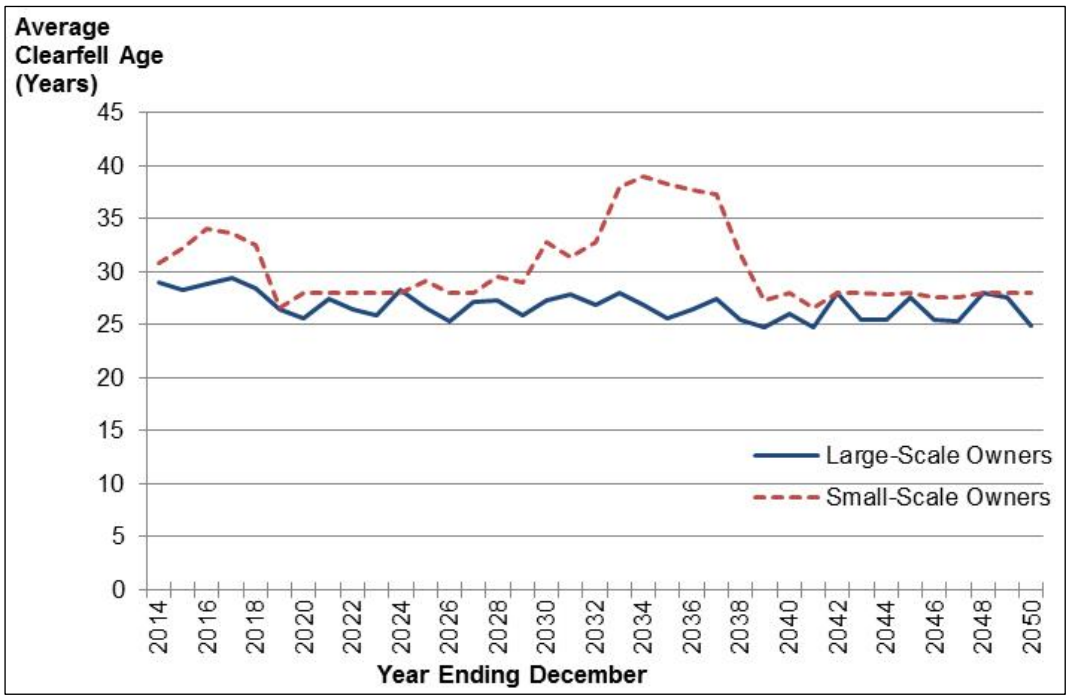


Figure 5-10: Southland Average Radiata Pine Clearfell Age under Scenario 3 – by Ownership Category



5.6 Scenario 4

Target rotation ages of 26 or 30 years are used (rather 28 years) and the same constraints are applied as Scenario 3 (Figure 5-11).

Because of the limitations imposed by the current age-class distribution and large-scale owners' stated harvest intentions, it takes some time to achieve separation of average clearfell age (Figure 5-12).

Figure 5-11: Southland Radiata Pine Availability by Target Rotation Age under Scenario 4 – All Owners

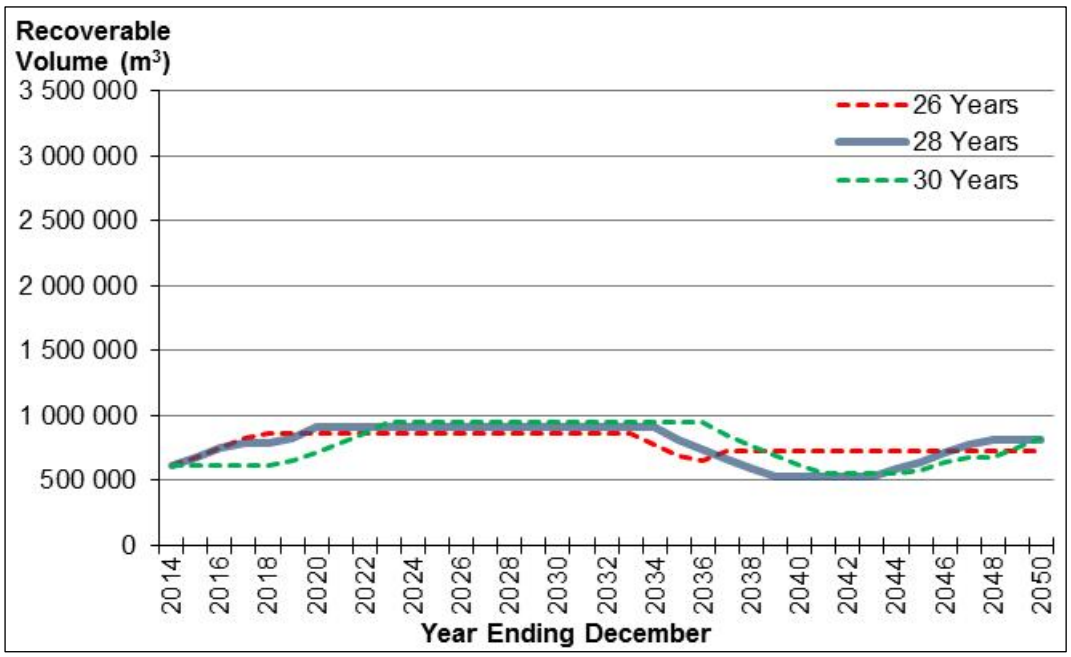
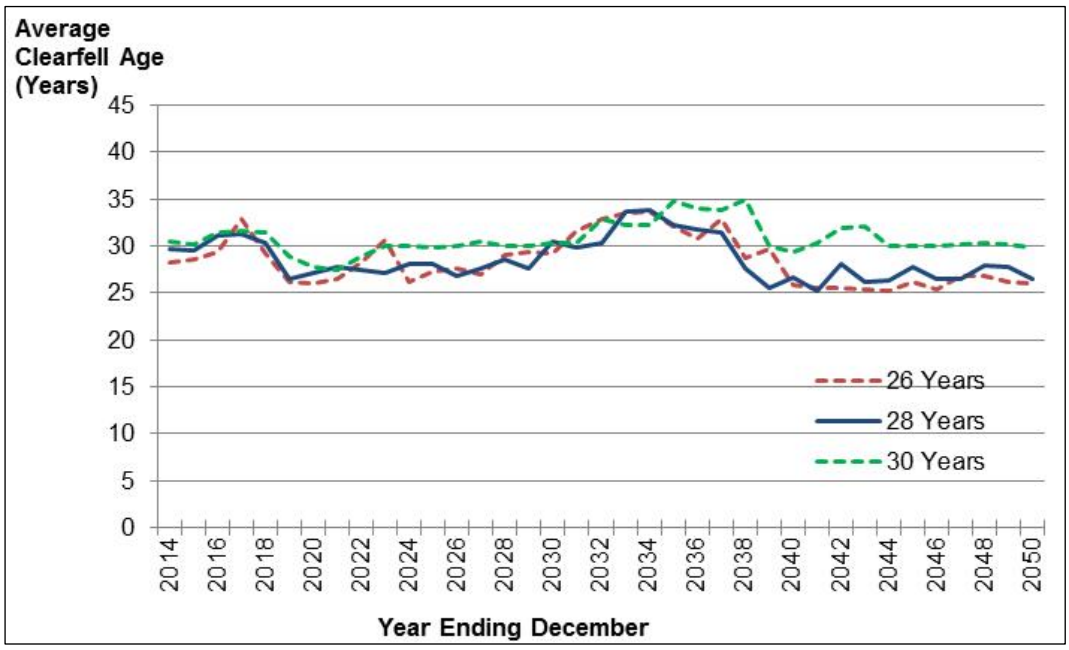


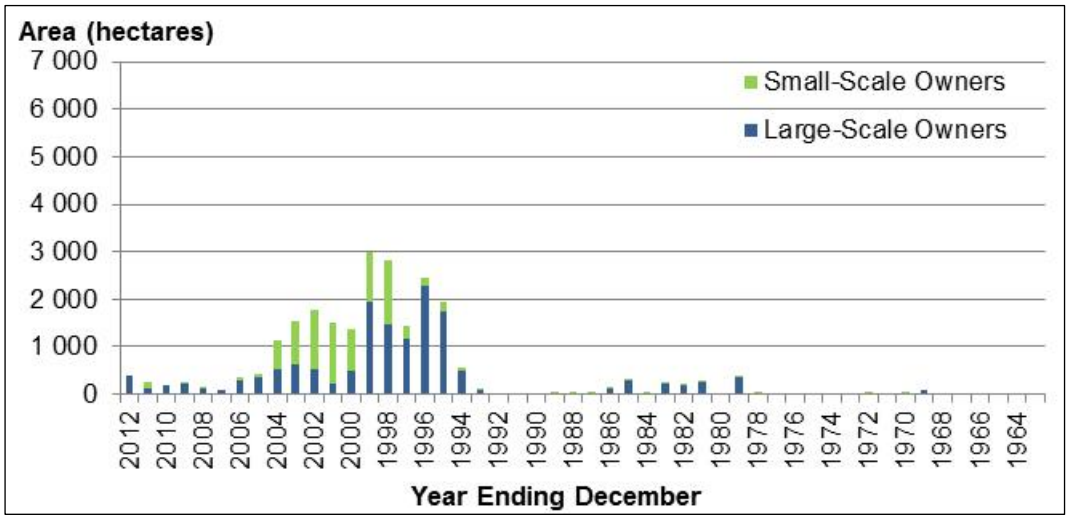
Figure 5-12: Southland Average Radiata Pine Clearfell Age by Target Rotation Age under Scenario 4



5.7 Douglas-fir

The age-class distribution of Douglas-fir in Southland is far from uniform (Figure 5-13). Large areas of Douglas-fir were established from 1995 to 2004. This age-class structure imposes challenges for yield regulation.

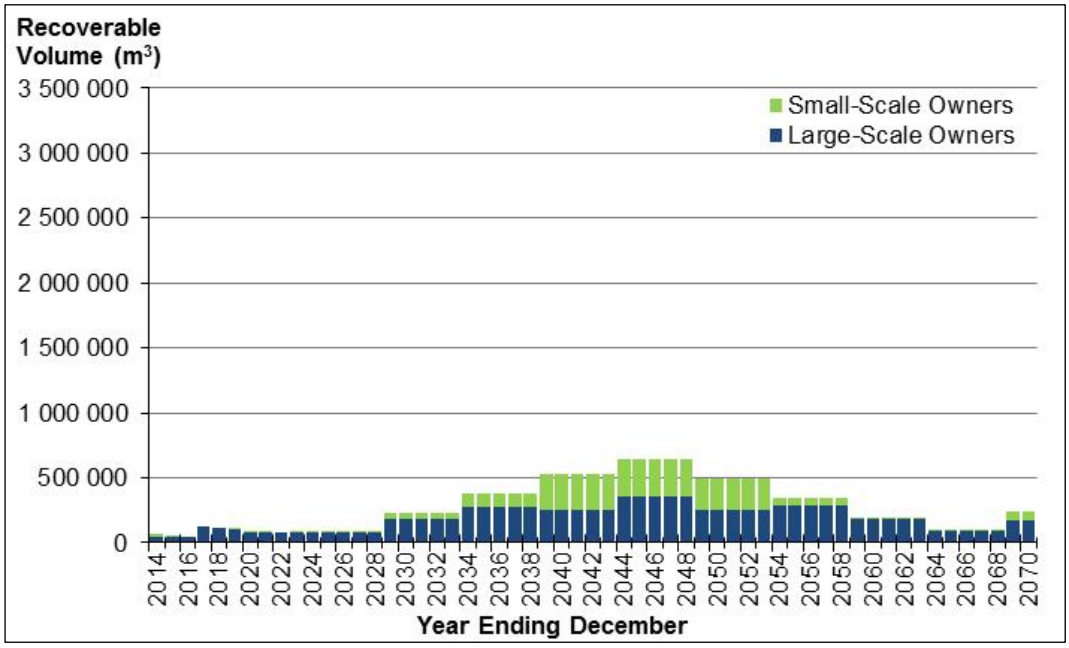
Figure 5-13: Southland Age-class Distribution of Douglas-fir – All Owners Estate as at 1 April 2013



The Douglas-fir harvest for the large-scale owners' estate is based on intentions for 2014 to 2023. After 2023, the wood availability from large-scale owners is modelled in five-year period non-declining yield (NDY) blocks (i.e. 2024-2028, 2029-2033, etc). The total wood availability of the combined estate is also modelled to be non-declining within each of the five-year period NDY blocks. The harvest level for the first five-year NDY block is set to be the same as in 2023. The availability of Douglas-fir from clearfell and production thinning operations can change by 100 000 m³ per year for the large-scale owners' estate and by 150 000 m³ per year for the combined estate. The target rotation age is 40 years for Douglas-fir.

Figure 5-14 shows the potential for an increase in the supply of this species in the long-term.

Figure 5-14: Southland Douglas-fir Availability – All Owners (includes volumes from production thinning as well as clearfell)



5.8 Douglas-fir & Radiata Pine Combined

Feedback from major forest owners in the region suggested Douglas-fir was often used to fill gaps in the radiata harvest profile[2]. It was therefore recommended that the radiata pine and Douglas-fir be modelled together. The radiata pine and Douglas-fir large owner estate was harvested as per their harvest intentions for the first 10 years. This scenario is very similar to the stand alone Douglas-fir scenario in Section 5.7, except the non-declining yield constraint is modelled at a combined level of the radiata and Douglas-fir estate. Figure 5-15 shows the resulting wood availability forecasts by species. The results suggest that from 2029 a sustainable harvest of 1.00 million m³ per year is possible from the combined radiata and Douglas-fir estates, with Douglas-fir increasing in importance from 2029 onwards.

[2] From an operational perspective (e.g. to maintain continuity of work-flow for harvest contractors) Douglas-fir can replace radiata pine. It is recognised, however, that if a substantial portion was to be substituted, then alternative markets may need to be developed.

Figure 5-15: Southland Douglas-fir & Radiata Pine Combined Availability – All Owners (includes volumes from production thinning as well as clearfell)

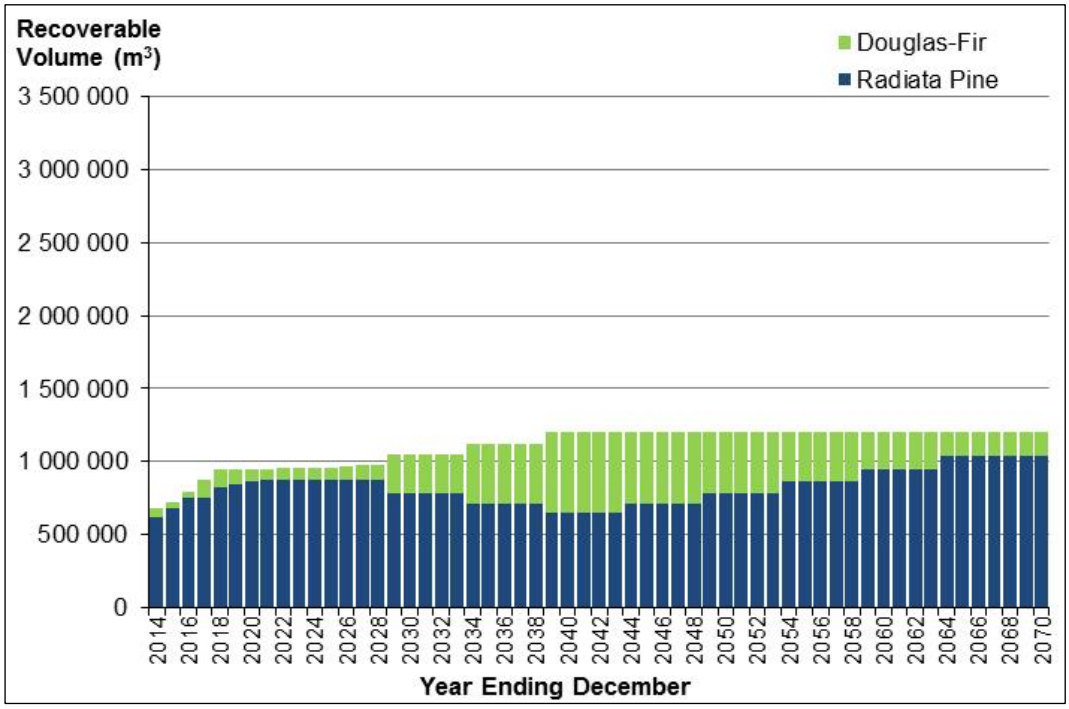
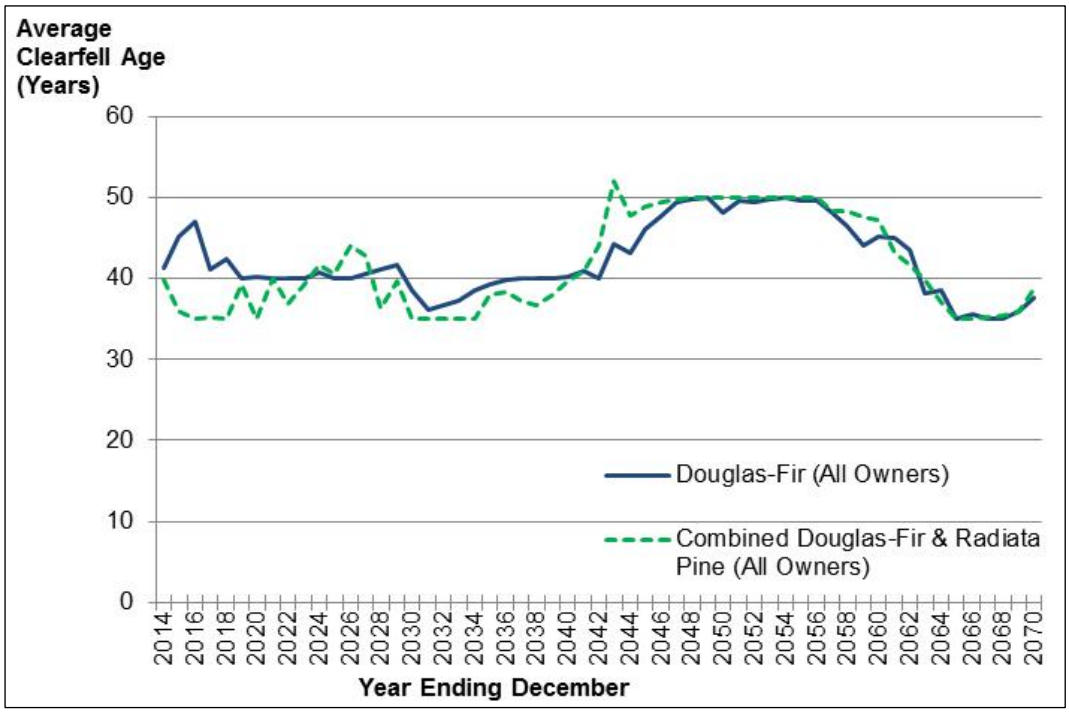


Figure 5-16 compares the rotation ages from the Douglas-fir only scenario, and the combined Douglas-fir and radiata pine scenario. It can be seen that there is little difference in terms of harvest age between the two scenarios.

Figure 5-16: Southland Average Douglas-fir Clearfell Age by Scenario – All Owners



6. WOOD AVAILABILITY FORECASTS FOR THE COMBINED OTAGO & SOUTHLAND ESTATE

The combined radiata pine forecasts for Otago and Southland are presented for scenario 2 (Figure 6-1 and Figure 6-2), scenario 3 (Figure 6-3, Figure 6-4 and Figure 6-5) and scenario 4 (Figure 6-6).

6.1 Scenario 2

The second scenario is based on a non-declining yield, and a target rotation of 28 years. Figure 6-1 indicates that wood availability from the Otago/Southland region will increase from 2015, although this is largely driven by an increase in harvest volumes from small-scale forest owners.

Figure 6-1: Otago & Southland Radiata Pine Availability under Scenario 2 – by Ownership Size

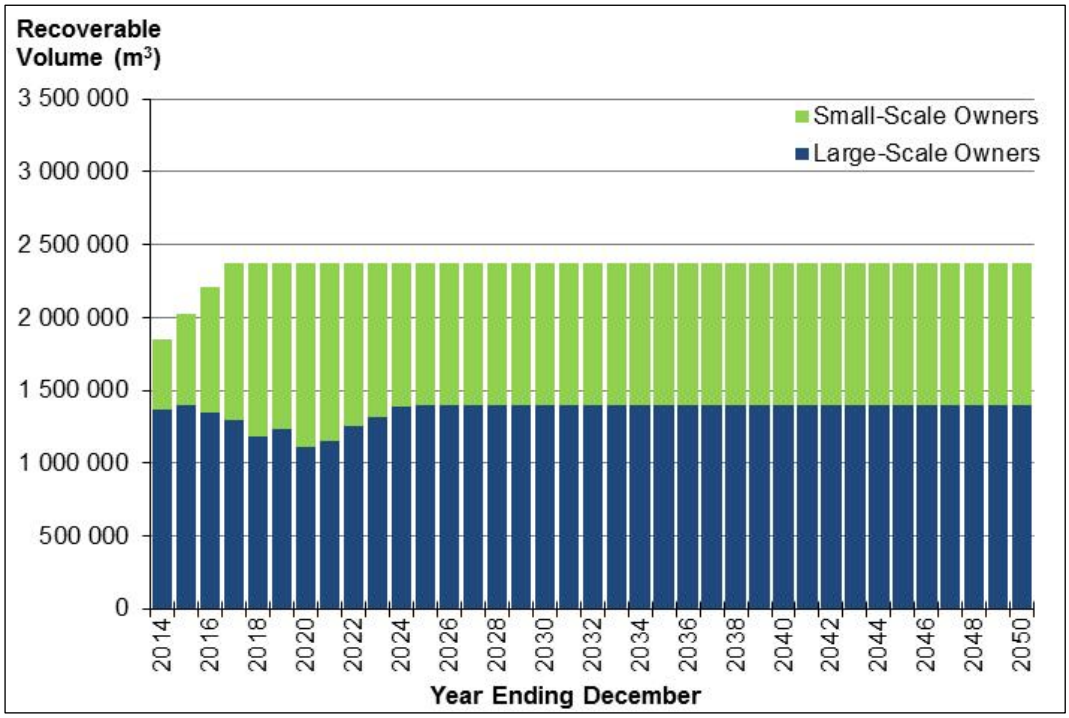
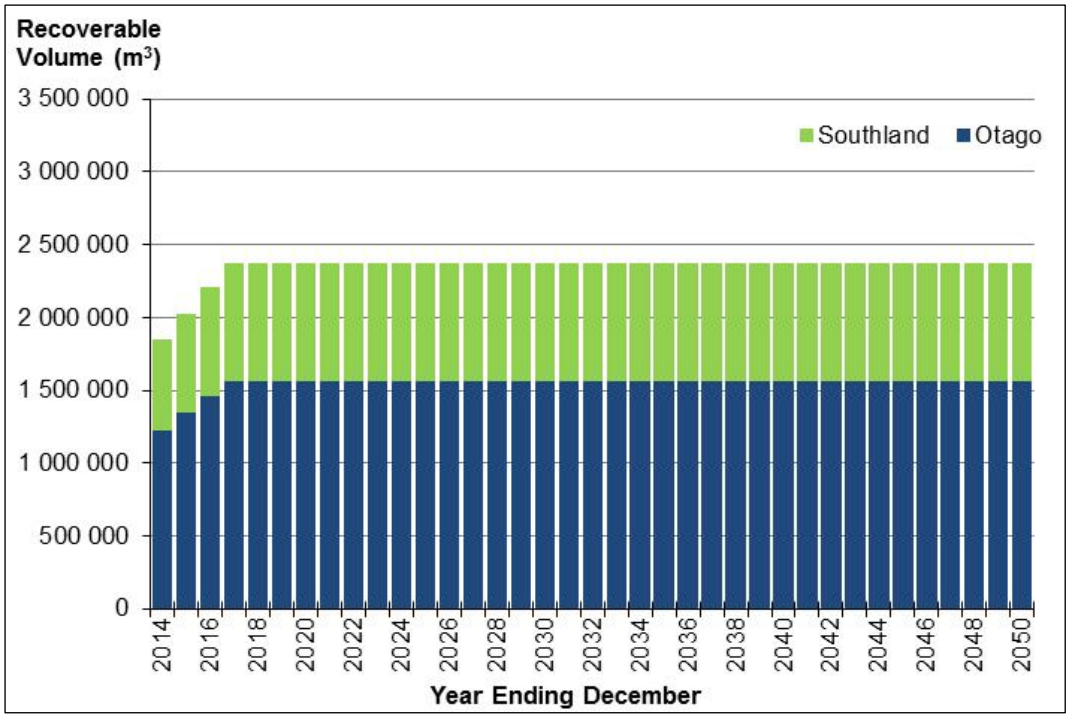


Figure 6-2: Otago & Southland Radiata Pine Availability under Scenario 2 – All Owners



6.2 Scenario 3

The third scenario is based on a split non-declining yield, with a target rotation age of 28 years (Figure 6-3 to Figure 6-5).

Figure 6-3: Otago & Southland Radiata Pine Availability under Scenario 3 – by Ownership Size

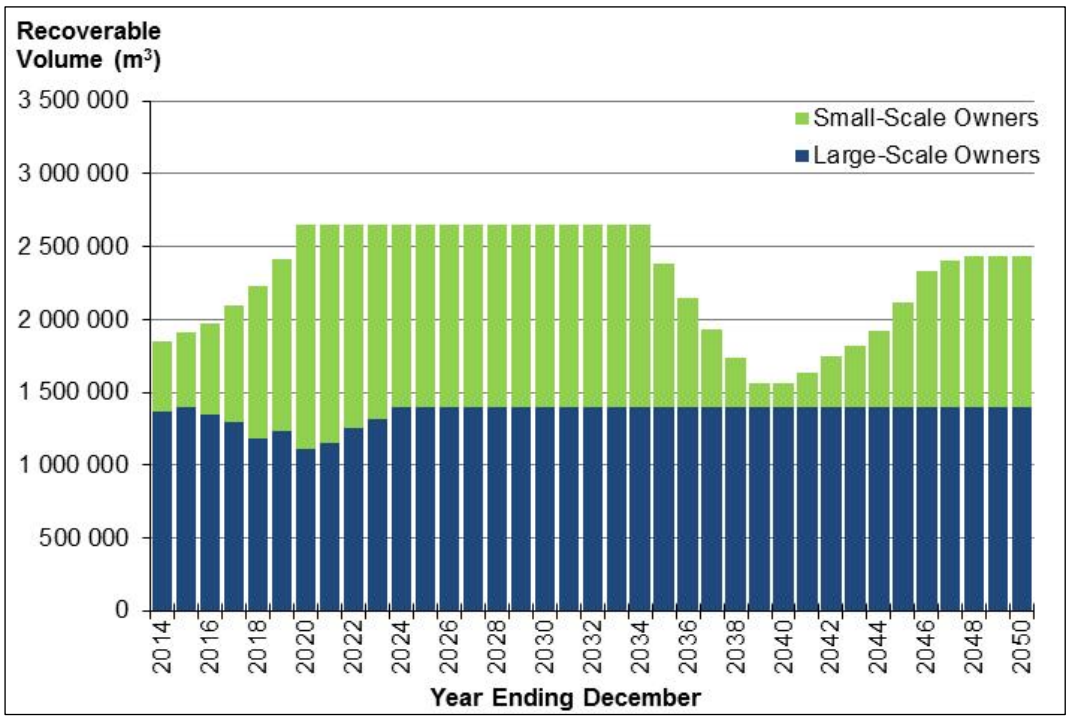


Figure 6-4: Otago & Southland Radiata Pine Availability under Scenario 3 – All Owners

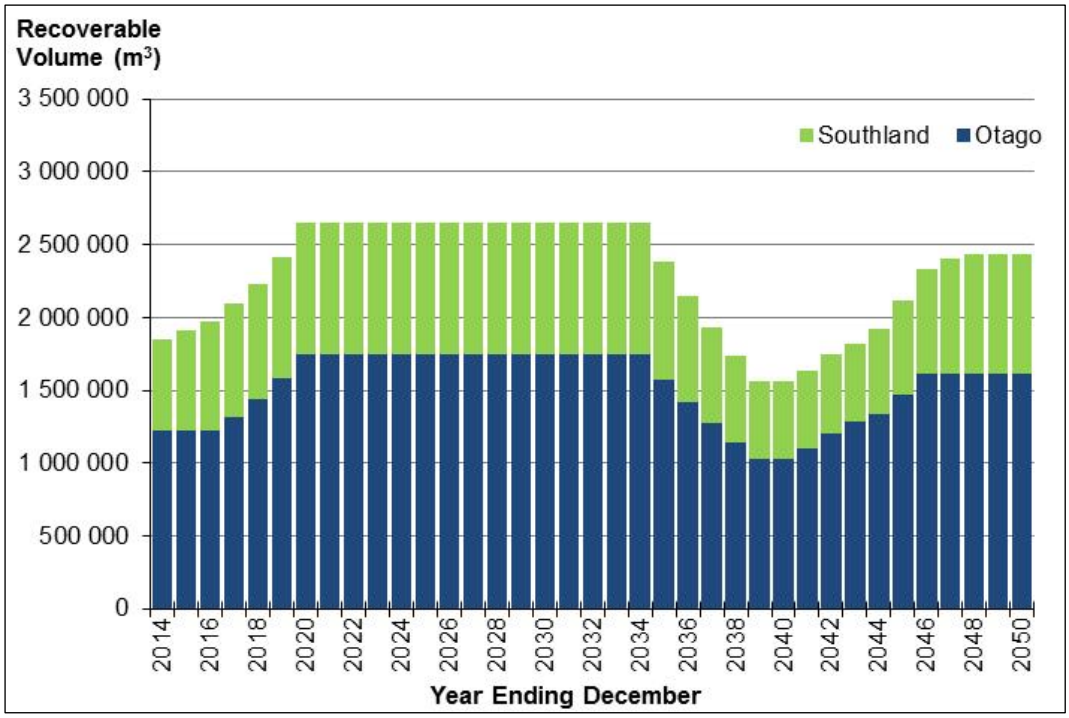
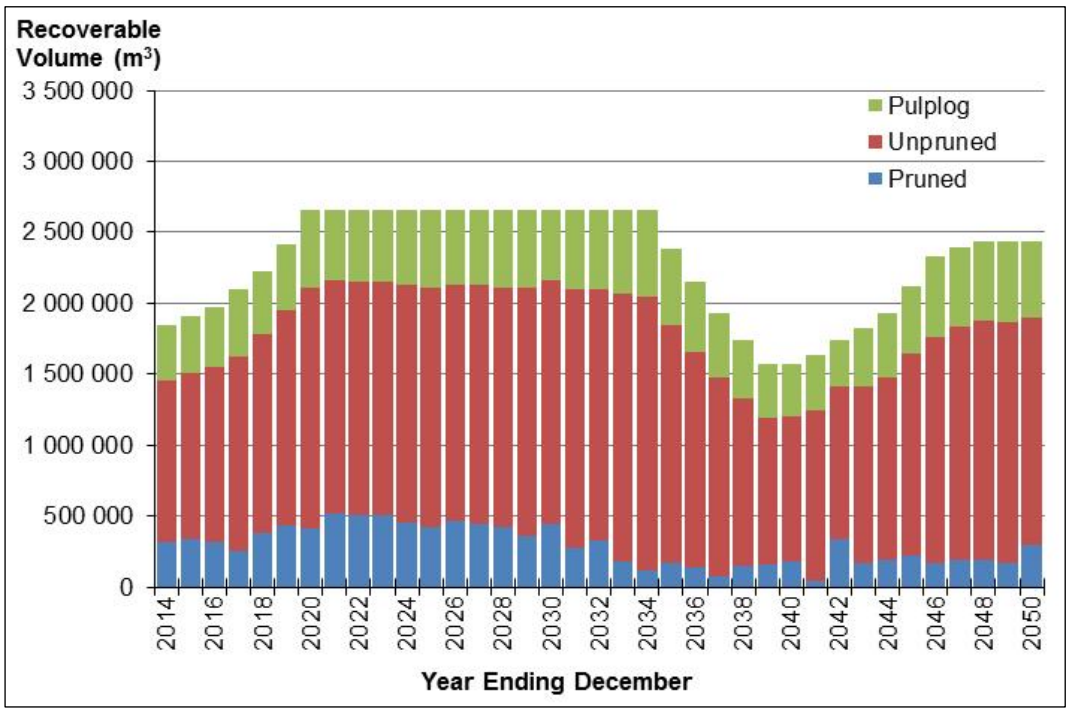


Figure 6-5: Otago & Southland Radiata Pine Availability under Scenario 3 – by Log Type

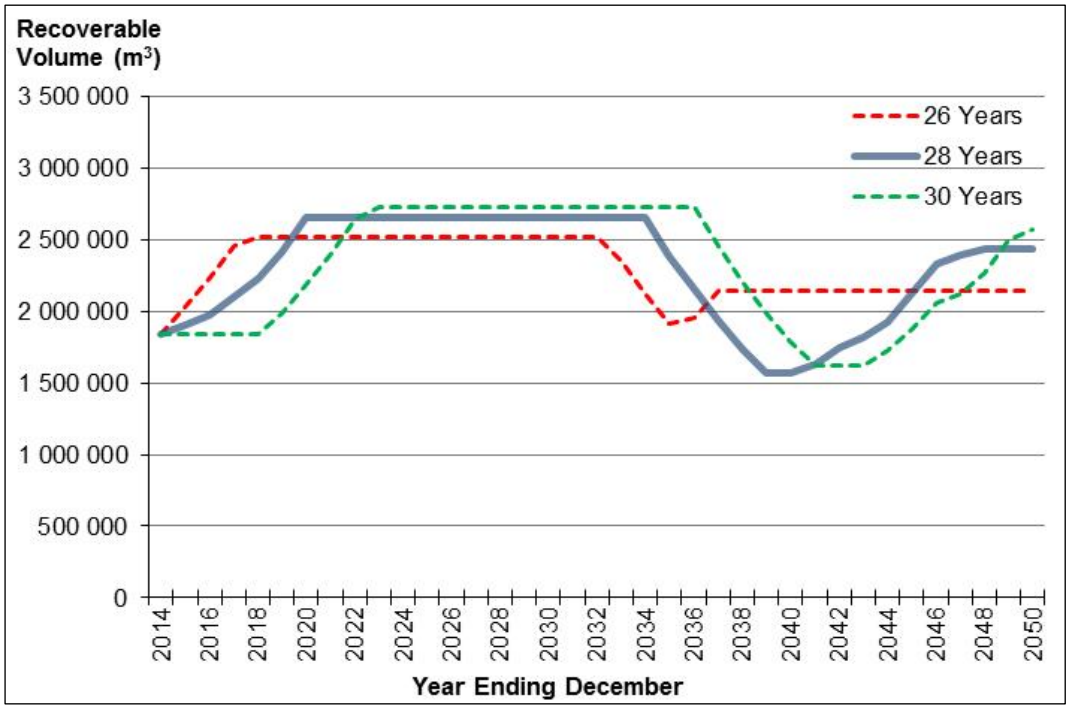


6.3 Scenario 4

Different wood availability profiles are generated if the target rotation age is altered from 28 years to either 26 or 30 years.

Figure 6-6 indicates a band of possible wood availability profiles. The harvest ages are somewhat constrained for the first ten years by the large-scale owners' harvest intentions and the requirement for a non-declining yield for the large owner's estate as well as the overall radiata pine estate. These constraints are loosened somewhat for the 26 and 30 year target rotations to allow these rotation lengths to be more closely matched.

Figure 6-6: Otago & Southland Radiata Pine Availability by Target Rotation Age under Scenario 4

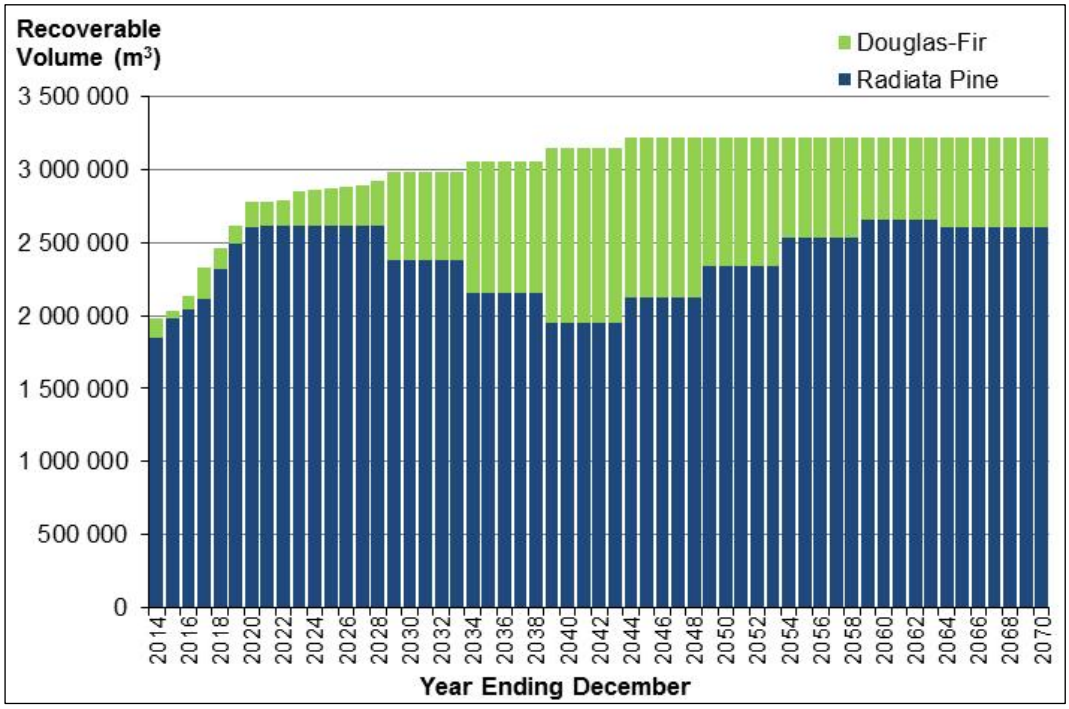


6.4 Douglas-fir & Radiata Pine Combined

Feedback from major forest owners in the region suggested Douglas-fir was often used to fill gaps in the radiata harvest profile[3]. It was therefore recommended that radiata pine and Douglas-fir be modelled together. The radiata pine and Douglas-fir large owner estate was harvested as per their harvest intentions for the first 10 years. Total harvest volumes were constrained to be non-declining, and the total harvest of Douglas-fir can change by 150 000 m³ per year for each region. Figure 6-7 shows the resulting wood availability forecasts. The results suggest that from 2029 a sustainable harvest of almost 3.0 million m³ per year is possible from the combined radiata and Douglas-fir estates, with Douglas-fir increasing in importance in fulfilling the non-declining yield constraint from 2029 onwards.

[3] From an operational perspective (e.g. to maintain continuity of work-flow for harvest contractors) Douglas-fir can replace radiata pine. It is recognised, however, that if a substantial portion was to be substituted, then alternative markets may need to be developed.

Figure 6-7: Otago & Southland Douglas-fir & Radiata Pine Combined Availability – All Owners (includes volumes from production thinning)



7. CONCLUDING COMMENTS

Wood availability from the Otago and Southland wood supply regions' planted forest resource is expected to be relatively static for the next one or two years. Between 2015 and 2020, significant volume increases are possible and thereafter sustained radiata pine annual harvests of around 2.4 million m³ are possible. Depending on the rate of harvesting from the region's post-1990 forests, the availability of radiata pine may decrease in the early to mid-2030s. However, in part this can be replaced by Douglas-fir which has the potential to make up an increasing component of the total harvest volume from 2029.

Scenario 4 shows that the actual annual radiata harvest level could vary between 1.5 million m³ and 2.7 million m³, depending on harvest age. Of this, approximately 1.0 to 1.7 million m³ will be potentially coming from Otago, and around 0.5 to 1.0 million m³ from Southland.

Most of the potential increase in wood availability from 2015 onwards will come from the region's small-scale forest owners who established forests during the 1990s. Market conditions and logistical constraints will determine the actual rate of harvest increase, and to what level is reached.

It should also be noted that additional volume will be available from the short rotation eucalyptus resource and other minor species in Otago and Southland, which are not included in these wood availability forecasts.

APPENDIX A

OTAGO WOOD AVAILABILITY FORECASTS - SUPPORTING TABLES

LIST OF TABLES

APPENDIX B

SOUTHLAND WOOD AVAILABILITY FORECASTS - SUPPORTING TABLES

LIST OF TABLES

APPENDIX C

OTAGO - SOUTHLAND COMBINED WOOD AVAILABILITY FORECASTS - SUPPORTING TABLES

LIST OF TABLES

A1: OTAGO RADIATA PINE AVAILABILITY UNDER SCENARIO ONE

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	945	549	1 494
2015	925	574	1 499
2016	915	92	1 007
2017	834	102	936
2018	768	214	982
2019	784	365	1 148
2020	792	1 675	2 467
2021	814	1 202	2 017
2022	910	2 369	3 279
2023	926	1 466	2 392
2024	1 008	1 358	2 366
2025	1 008	649	1 656
2026	1 008	828	1 835
2027	1 008	670	1 677
2028	1 008	604	1 612
2029	1 008	414	1 421
2030	1 008	153	1 161
2031	1 008	355	1 363
2032	1 008	106	1 113
2033	1 008	148	1 156
2034	1 008	37	1 044
2035	1 008	70	1 078
2036	1 008	103	1 111
2037	1 008	42	1 049
2038	1 008	35	1 043
2039	1 008	71	1 078
2040	1 008	81	1 088
2041	1 008	0	1 008
2042	1 008	431	1 439
2043	1 008	530	1 538
2044	1 008	497	1 504
2045	1 008	101	1 109
2046	1 008	112	1 120
2047	1 008	212	1 219
2048	1 008	359	1 366
2049	1 008	1 650	2 657
2050	1 008	1 186	2 193

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A2: OTAGO RADIATA PINE AVAILABILITY UNDER SCENARIO TWO

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	945	280	1 225
2015	925	423	1 348
2016	915	543	1 458
2017	834	731	1 565
2018	768	797	1 565
2019	784	781	1 565
2020	792	773	1 565
2021	814	750	1 565
2022	910	655	1 565
2023	926	638	1 565
2024	998	566	1 565
2025	1 008	556	1 565
2026	1 008	556	1 565
2027	1 008	556	1 565
2028	1 008	556	1 565
2029	1 008	556	1 565
2030	1 008	556	1 565
2031	1 008	556	1 565
2032	1 008	556	1 565
2033	1 008	556	1 565
2034	1 008	556	1 565
2035	1 008	556	1 565
2036	1 008	556	1 565
2037	1 008	556	1 565
2038	1 008	556	1 565
2039	1 008	556	1 565
2040	1 008	556	1 565
2041	1 008	556	1 565
2042	1 008	556	1 565
2043	1 008	556	1 565
2044	1 008	556	1 565
2045	1 008	556	1 565
2046	1 008	556	1 565
2047	1 008	556	1 565
2048	1 008	556	1 565
2049	1 008	556	1 565
2050	1 008	556	1 565

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A3: OTAGO RADIATA PINE AVAILABILITY UNDER SCENARIO THREE

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	945	280	1 225
2015	925	301	1 225
2016	915	310	1 225
2017	834	477	1 311
2018	768	674	1 442
2019	784	803	1 586
2020	792	953	1 745
2021	814	931	1 745
2022	910	835	1 745
2023	926	819	1 745
2024	1 008	737	1 745
2025	1 008	737	1 745
2026	1 008	737	1 745
2027	1 008	737	1 745
2028	1 008	737	1 745
2029	1 008	737	1 745
2030	1 008	737	1 745
2031	1 008	737	1 745
2032	1 008	737	1 745
2033	1 008	737	1 745
2034	1 008	737	1 745
2035	1 008	563	1 570
2036	1 008	406	1 413
2037	1 008	264	1 272
2038	1 008	137	1 145
2039	1 008	22	1 030
2040	1 008	22	1 030
2041	1 008	90	1 098
2042	1 008	200	1 208
2043	1 008	277	1 285
2044	1 008	331	1 339
2045	1 008	465	1 473
2046	1 008	609	1 617
2047	1 008	609	1 617
2048	1 008	609	1 617
2049	1 008	609	1 617
2050	1 008	609	1 617

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A4: OTAGO RADIATA PINE AVAILABILITY UNDER SCENARIO THREE - BY LOG GRADE FOR ALL OWNERS

Year Ending December	Pruned (000 m^3 IB)	Unpruned (000 m^3 IB)	Chip Logs (000 m^3 IB)	Total (000 m^3 IB)
2014	255	741	229	1 225
2015	257	740	228	1 225
2016	253	746	227	1 225
2017	219	842	250	1 311
2018	326	877	239	1 442
2019	366	963	258	1 586
2020	325	1 091	329	1 745
2021	394	1 058	293	1 745
2022	373	1 082	290	1 745
2023	378	1 073	294	1 745
2024	310	1 110	325	1 745
2025	300	1 108	336	1 745
2026	356	1 084	305	1 745
2027	345	1 083	316	1 745
2028	284	1 113	348	1 745
2029	279	1 138	327	1 745
2030	355	1 094	296	1 745
2031	230	1 165	350	1 745
2032	254	1 146	345	1 745
2033	156	1 206	382	1 745
2034	104	1 239	403	1 745
2035	128	1 093	350	1 570
2036	93	994	326	1 413
2037	45	922	306	1 272
2038	115	763	267	1 145
2039	126	674	230	1 030
2040	121	678	231	1 030
2041	22	832	244	1 098
2042	256	742	210	1 208
2043	132	880	274	1 285
2044	156	879	304	1 339
2045	190	958	324	1 473
2046	144	1 087	386	1 617
2047	151	1 092	374	1 617
2048	147	1 099	371	1 617
2049	142	1 102	373	1 617
2050	219	1 063	335	1 617

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A5: OTAGO RADIATA PINE RECOVERABLE VOLUME AND AVERAGE CLEARFELL AGE FOR EACH TARGET ROTATION AGE UNDER SCENARIO FOUR, FOR ALL OWNERS (TARGET ROTATIONS OF 26, 28 AND 30 YEARS)

Year Ending December	26-YEAR ROTATION		28-YEAR ROTATION		30-YEAR ROTATION	
	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)
2014	1 225	27	1 225	29	1 225	31
2015	1 348	29	1 225	30	1 225	31
2016	1 483	30	1 225	30	1 225	31
2017	1 631	32	1 311	32	1 225	31
2018	1 665	28	1 442	30	1 225	29
2019	1 665	29	1 586	30	1 334	27
2020	1 665	27	1 745	28	1 467	28
2021	1 665	26	1 745	28	1 614	29
2022	1 665	29	1 745	29	1 775	30
2023	1 665	30	1 745	28	1 775	30
2024	1 665	28	1 745	29	1 775	32
2025	1 665	28	1 745	29	1 775	30
2026	1 665	28	1 745	29	1 775	30
2027	1 665	28	1 745	28	1 775	30
2028	1 665	29	1 745	28	1 775	30
2029	1 665	28	1 745	31	1 775	30
2030	1 665	30	1 745	30	1 775	30
2031	1 665	31	1 745	32	1 775	31
2032	1 665	33	1 745	32	1 775	32
2033	1 498	33	1 745	33	1 775	32
2034	1 348	31	1 745	33	1 775	33
2035	1 213	35	1 570	33	1 775	33
2036	1 294	31	1 413	32	1 775	34
2037	1 424	30	1 272	33	1 598	33
2038	1 424	30	1 145	28	1 438	31
2039	1 424	37	1 030	28	1 294	34
2040	1 424	26	1 030	28	1 165	30
2041	1 424	26	1 098	39	1 062	34
2042	1 424	29	1 208	28	1 062	35
2043	1 424	25	1 285	32	1 062	32
2044	1 424	26	1 339	28	1 168	30
2045	1 424	28	1 473	28	1 285	30
2046	1 424	27	1 617	28	1 413	31
2047	1 424	27	1 617	29	1 440	30
2048	1 424	27	1 617	30	1 584	29
2049	1 424	27	1 617	30	1 742	32
2050	1 424	29	1 617	29	1 742	32

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A6: OTAGO DOUGLAS-FIR AVAILABILITY - COMBINED ESTATE (INCLUDES VOLUMES FROM PRODUCTION THINNING AS WELL AS CLEARFELL)

Year Ending December	Recoverable Volume (000 m^3 IB)	Average Age (Years)
2014	65	42
2015	6	43
2016	36	41
2017	88	41
2018	23	40
2019	30	40
2020	105	40
2021	82	40
2022	64	40
2023	173	40
2024	173	40
2025	173	40
2026	173	40
2027	173	40
2028	173	42
2029	323	46
2030	323	45
2031	323	45
2032	323	45
2033	323	43
2034	473	45
2035	473	39
2036	473	40
2037	473	40
2038	473	40
2039	623	40
2040	623	40
2041	623	41
2042	623	46
2043	623	46
2044	669	45
2045	669	46
2046	669	48
2047	669	50
2048	669	50
2049	519	50
2050	519	50

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

A7: OTAGO DOUGLAS-FIR & RADIATA PINE COMBINED AVAILABILITY - ALL OWNERS (INCLUDES VOLUMES FROM PRODUCTION THINNING AS WELL AS CLEARFELL)

Year Ending December	Radiata Pine Recoverable Volume (000 m^3 IB)	Radiata Pine Average Age (Years)	Douglas-Fir Recoverable Volume (000 m^3 IB)	Douglas-Fir Average Age (Years)
2014	1 225	29	77	41
2015	1 296	30	6	43
2016	1 296	30	36	41
2017	1 358	31	88	40
2018	1 494	30	19	40
2019	1 643	30	21	40
2020	1 742	28	88	40
2021	1 744	28	86	40
2022	1 744	29	86	40
2023	1 744	28	153	40
2024	1 744	29	159	40
2025	1 744	29	173	40
2026	1 744	29	173	40
2027	1 744	28	177	40
2028	1 744	29	195	42
2029	1 594	31	345	45
2030	1 594	30	345	44
2031	1 594	31	345	44
2032	1 594	31	345	44
2033	1 594	32	345	42
2034	1 444	32	495	44
2035	1 444	32	495	38
2036	1 444	32	495	40
2037	1 444	35	495	40
2038	1 444	32	495	40
2039	1 300	27	645	40
2040	1 300	28	645	40
2041	1 300	37	645	41
2042	1 300	28	645	46
2043	1 300	31	645	47
2044	1 414	27	603	45
2045	1 414	28	603	46
2046	1 414	29	603	48
2047	1 414	29	603	50
2048	1 414	30	603	50
2049	1 555	30	461	50
2050	1 555	30	461	50

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B1: SOUTHLAND RADIATA PINE AVAILABILITY UNDER SCENARIO ONE

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	425	193	618
2015	469	883	1 351
2016	431	40	470
2017	462	54	515
2018	419	198	617
2019	448	95	543
2020	317	686	1 002
2021	337	725	1 062
2022	348	1 696	2 044
2023	389	991	1 379
2024	389	589	978
2025	389	322	711
2026	389	998	1 387
2027	389	611	1 000
2028	389	351	740
2029	389	416	805
2030	389	148	537
2031	389	234	623
2032	389	258	647
2033	389	48	436
2034	389	43	432
2035	389	60	449
2036	389	32	421
2037	389	42	430
2038	389	60	449
2039	389	116	505
2040	389	207	595
2041	389	0	389
2042	389	318	707
2043	389	183	572
2044	389	753	1 142
2045	389	43	432
2046	389	59	448
2047	389	199	588
2048	389	95	484
2049	389	690	1 079
2050	389	730	1 119

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B2: SOUTHLAND RADIATA PINE AVAILABILITY UNDER SCENARIO

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	425	194	619
2015	469	212	681
2016	431	318	749
2017	462	348	809
2018	419	390	809
2019	448	361	809
2020	317	493	809
2021	337	472	809
2022	348	461	809
2023	389	420	809
2024	389	420	809
2025	389	420	809
2026	389	420	809
2027	389	420	809
2028	389	420	809
2029	389	420	809
2030	389	420	809
2031	389	420	809
2032	389	420	809
2033	389	420	809
2034	389	420	809
2035	389	420	809
2036	389	420	809
2037	389	420	809
2038	389	420	809
2039	389	420	809
2040	389	420	809
2041	389	420	809
2042	389	420	809
2043	389	420	809
2044	389	420	809
2045	389	420	809
2046	389	420	809
2047	389	420	809
2048	389	420	809
2049	389	420	809
2050	389	420	809

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B3: SOUTHLAND RADIATA PINE AVAILABILITY UNDER SCENARIO THREE

Year Ending December	Large-Scale Owners (000 m^3 IB)	Small-Scale Owners (000 m^3 IB)	All Owners (000 m^3 IB)
2014	425	194	619
2015	469	212	681
2016	431	318	749
2017	462	324	785
2018	419	366	785
2019	448	377	825
2020	317	591	907
2021	337	570	907
2022	348	559	907
2023	389	518	907
2024	389	518	907
2025	389	518	907
2026	389	518	907
2027	389	518	907
2028	389	518	907
2029	389	518	907
2030	389	518	907
2031	389	518	907
2032	389	518	907
2033	389	518	907
2034	389	518	907
2035	389	428	816
2036	389	346	735
2037	389	273	661
2038	389	206	595
2039	389	147	536
2040	389	147	536
2041	389	147	536
2042	389	147	536
2043	389	147	536
2044	389	198	587
2045	389	257	646
2046	389	321	710
2047	389	392	781
2048	389	429	817
2049	389	429	817
2050	389	429	817

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B4: SOUTHLAND RADIATA PINE AVAILABILITY UNDER SCENARIO THREE - BY LOG GRADE FOR ALL OWNERS

Year Ending December	Pruned (000 m^3 IB)	Unpruned (000 m^3 IB)	Chip Logs (000 m^3 IB)	Total (000 m^3 IB)
2014	64	399	156	619
2015	76	435	170	681
2016	66	489	194	749
2017	30	528	228	785
2018	51	531	204	785
2019	65	556	204	825
2020	89	604	215	907
2021	120	584	203	907
2022	137	562	208	907
2023	125	570	212	907
2024	143	565	199	907
2025	118	582	207	907
2026	112	578	217	907
2027	96	603	208	907
2028	133	575	200	907
2029	80	613	214	907
2030	85	623	199	907
2031	47	659	202	907
2032	67	634	206	907
2033	21	688	198	907
2034	14	689	204	907
2035	36	591	190	816
2036	42	528	165	735
2037	24	487	150	661
2038	35	411	149	595
2039	29	366	140	536
2040	56	348	131	536
2041	20	372	144	536
2042	82	336	117	536
2043	33	366	137	536
2044	38	401	148	587
2045	31	465	150	646
2046	20	512	178	710
2047	43	546	193	781
2048	42	589	187	817
2049	30	597	191	817
2050	79	538	201	817

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B5: SOUTHLAND RADIATA PINE RECOVERABLE VOLUME AND AVERAGE CLEARFELL AGE FOR EACH TARGET ROTATION AGE UNDER SCENARIO FOUR. FOR ALL OWNERS (TARGET ROTATIONS OF 26. 28 AND 30 YEARS)

Year Ending December	26-YEAR ROTATION		28-YEAR ROTATION		30-YEAR ROTATION	
	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)
2014	619	28	619	30	619	31
2015	681	29	681	30	619	30
2016	749	29	749	31	619	31
2017	824	33	785	31	619	32
2018	858	29	785	30	619	31
2019	858	26	825	26	649	29
2020	858	26	907	27	714	28
2021	858	27	907	28	785	27
2022	858	28	907	27	863	29
2023	858	31	907	27	950	30
2024	858	26	907	28	950	30
2025	858	27	907	28	950	30
2026	858	28	907	27	950	30
2027	858	27	907	28	950	30
2028	858	29	907	29	950	30
2029	858	29	907	28	950	30
2030	858	29	907	30	950	30
2031	858	32	907	30	950	30
2032	858	33	907	30	950	33
2033	858	34	907	34	950	32
2034	772	34	907	34	950	32
2035	695	32	816	32	950	35
2036	658	31	735	32	950	34
2037	724	33	661	31	855	34
2038	724	29	595	28	769	35
2039	724	30	536	26	692	30
2040	724	26	536	27	623	29
2041	724	26	536	25	561	30
2042	724	25	536	28	561	32
2043	724	25	536	26	561	32
2044	724	25	587	26	561	30
2045	724	26	646	28	583	30
2046	724	25	710	26	642	30
2047	724	27	781	26	684	30
2048	724	27	817	28	684	30
2049	724	26	817	28	752	30
2050	724	26	817	26	827	30

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B6: SOUTHLAND DOUGLAS-FIR AVAILABILITY - COMBINED ESTATE (INCLUDES VOLUMES FROM PRODUCTION THINNING AS WELL AS CLEARFELL)

Year Ending December	Recoverable Volume ($000\ m^3$ IB)	Average Age (Years)
2014	74	41
2015	53	45
2016	48	47
2017	127	41
2018	119	42
2019	106	40
2020	95	40
2021	81	40
2022	83	40
2023	82	40
2024	82	41
2025	82	40
2026	82	40
2027	82	40
2028	82	41
2029	232	42
2030	232	38
2031	232	36
2032	232	37
2033	232	37
2034	382	38
2035	382	39
2036	382	40
2037	382	40
2038	382	40
2039	532	40
2040	532	40
2041	532	41
2042	532	40
2043	532	44
2044	649	43
2045	649	46
2046	649	48
2047	649	49
2048	649	50
2049	499	50
2050	499	48

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

B7: SOUTHLAND DOUGLAS-FIR & RADIATA PINE COMBINED AVAILABILITY - ALL OWNERS (INCLUDES VOLUMES FROM PRODUCTION THINNING AS WELL AS CLEARFELL)

Year Ending December	Radiata Pine Recoverable Volume (000 m^3 IB)	Radiata Pine Average Age (Years)	Douglas-Fir Recoverable Volume (000 m^3 IB)	Douglas-Fir Average Age (Years)
2014	619	30	63	40
2015	681	30	45	36
2016	749	31	48	35
2017	750	31	127	35
2018	825	30	119	35
2019	845	27	105	39
2020	865	27	85	35
2021	871	28	78	40
2022	871	27	83	37
2023	874	27	80	39
2024	874	28	80	42
2025	874	28	81	41
2026	874	27	89	44
2027	874	27	98	43
2028	874	29	108	36
2029	787	29	258	40
2030	787	31	258	35
2031	787	31	258	35
2032	787	31	258	35
2033	787	34	258	35
2034	708	33	408	35
2035	708	33	408	38
2036	708	32	408	38
2037	708	32	408	37
2038	708	32	408	37
2039	649	31	553	38
2040	649	31	553	40
2041	649	31	553	41
2042	649	32	553	44
2043	649	30	553	52
2044	714	30	489	48
2045	714	30	489	49
2046	714	30	489	49
2047	714	26	489	50
2048	714	32	489	50
2049	785	31	417	50
2050	785	30	417	50

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

C1: OTAGO - SOUTHLAND RADIATA PINE AVAILABILITY UNDER SCENARIO THREE - BY LOG TYPE

Year Ending December	Pruned (000 m^3 IB)	Unpruned (000 m^3 IB)	Chip Logs (000 m^3 IB)	Total (000 m^3 IB)
2014	319	1 140	385	1 844
2015	334	1 175	398	1 906
2016	319	1 235	420	1 974
2017	249	1 370	477	2 096
2018	377	1 408	443	2 228
2019	431	1 519	461	2 411
2020	414	1 695	544	2 652
2021	515	1 642	496	2 652
2022	510	1 644	498	2 652
2023	503	1 643	506	2 652
2024	453	1 675	524	2 652
2025	419	1 690	543	2 652
2026	468	1 662	522	2 652
2027	442	1 687	524	2 652
2028	417	1 687	548	2 652
2029	359	1 751	542	2 652
2030	440	1 717	495	2 652
2031	276	1 824	552	2 652
2032	322	1 780	550	2 652
2033	178	1 894	580	2 652
2034	118	1 928	606	2 652
2035	164	1 684	539	2 387
2036	135	1 522	492	2 148
2037	69	1 409	455	1 933
2038	150	1 174	416	1 740
2039	155	1 040	370	1 566
2040	177	1 027	363	1 566
2041	42	1 204	388	1 633
2042	338	1 078	327	1 743
2043	164	1 246	411	1 821
2044	194	1 280	452	1 926
2045	221	1 423	474	2 118
2046	164	1 600	564	2 327
2047	194	1 638	567	2 398
2048	189	1 688	558	2 435
2049	171	1 699	564	2 435
2050	298	1 601	536	2 435

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

C2: OTAGO & SOUTHLAND RADIATA PINE AVAILABILITY BY TARGET ROTATION AGE UNDER SCENARIO FOUR (TARGET ROTATIONS OF 26, 28 AND 30 YEARS)

Year Ending December	26-YEAR ROTATION		28-YEAR ROTATION		30-YEAR ROTATION	
	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)	Recoverable Volume (000 m^3 IB)	Average Age (Years)
2014	1 844	28	1 844	29	1 844	31
2015	2 029	29	1 906	30	1 844	31
2016	2 232	30	1 974	31	1 844	31
2017	2 455	32	2 096	32	1 844	31
2018	2 522	28	2 228	30	1 844	30
2019	2 522	28	2 411	29	1 983	28
2020	2 522	26	2 652	28	2 181	28
2021	2 522	26	2 652	28	2 399	28
2022	2 522	29	2 652	29	2 639	30
2023	2 522	30	2 652	28	2 725	30
2024	2 522	28	2 652	29	2 725	31
2025	2 522	28	2 652	28	2 725	30
2026	2 522	28	2 652	28	2 725	30
2027	2 522	28	2 652	28	2 725	30
2028	2 522	29	2 652	28	2 725	30
2029	2 522	29	2 652	30	2 725	30
2030	2 522	30	2 652	30	2 725	30
2031	2 522	31	2 652	31	2 725	31
2032	2 522	33	2 652	31	2 725	32
2033	2 356	33	2 652	33	2 725	32
2034	2 120	32	2 652	34	2 725	33
2035	1 908	34	2 387	32	2 725	34
2036	1 953	31	2 148	32	2 725	34
2037	2 148	31	1 933	33	2 453	33
2038	2 148	29	1 740	28	2 207	32
2039	2 148	34	1 566	27	1 987	33
2040	2 148	26	1 566	28	1 788	30
2041	2 148	26	1 633	34	1 623	33
2042	2 148	28	1 743	28	1 623	34
2043	2 148	25	1 821	30	1 623	32
2044	2 148	26	1 926	27	1 729	30
2045	2 148	27	2 118	28	1 868	30
2046	2 148	26	2 327	28	2 055	30
2047	2 148	27	2 398	28	2 124	30
2048	2 148	27	2 435	29	2 268	30
2049	2 148	27	2 435	29	2 494	31
2050	2 148	28	2 435	28	2 570	31

Note: IB denotes inside bark: the recoverable volume of wood excluding bark.

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