NEW ZEALAND
WOOD AVAILABILITY FORECASTS 2010–2040

Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere

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1 OVERVIEW

New Zealand has a planted production forest estate of approximately 1.8 million hectares[1]. Radiata pine makes up 89 percent (1 575 000 hectares) of this area and Douglas-fir 6 percent (111 000 hectares). The remainder of the area (75 000 hectares) is planted in eucalypt species, cypress species and numerous other softwood and hardwood species.

The forecasts in this report are for radiata pine and Douglas-fir which together make up 95 percent of the total area. Forecasts of wood availability from the area in other species have not produced due to the more limited data available for these species.

Figure 1.1 shows the age structure of New Zealand's radiata pine production forests used for the national wood availability forecasts. The peaks in forest area are the key driver of future increases in wood availability. The first peak planted between 1982 and 1986 (aged 22 to 26 years in 2008) has about 50 000 hectares in each age class. This area drives the increase in wood availability through to 2015. The second peak is the result of the mid-1990s planting boom (trees aged 11 to 15 years), with between 70 000 and 100 000 hectares in each age class. These areas reach harvestable age leading into the 2020s.

For further information on the forest resource description see www.maf.govt.nz/mafnet/publications/nefd/.

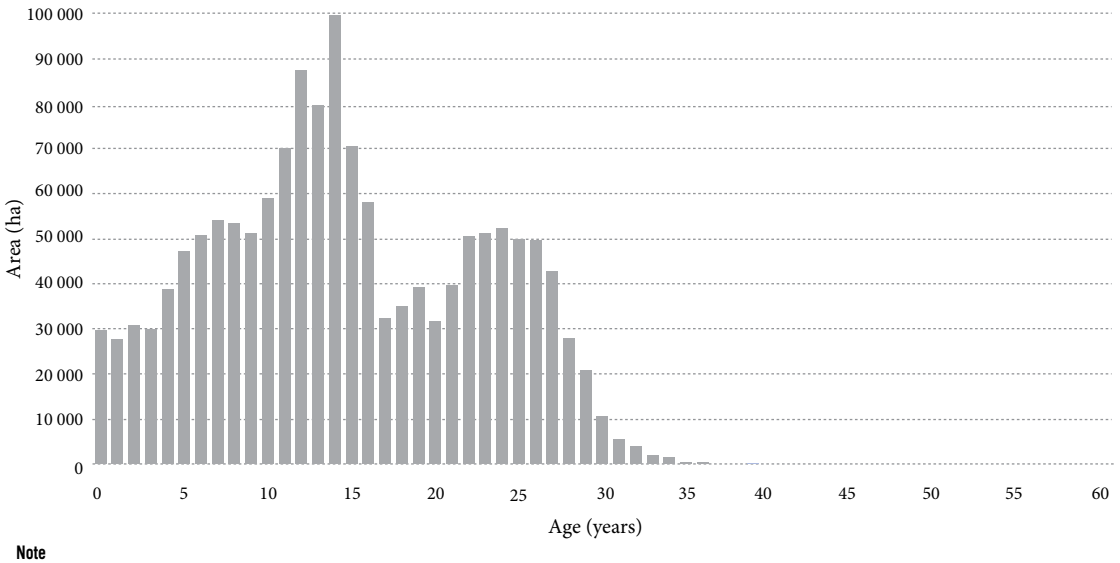
To assist with future regional forest industry planning, MAF has compiled wood availability forecasts for 13 regions covering the period 2008 to 2040. Table 1.1 lists the regions together with forecast details. The forecasts were produced in association with the major forest growers and consultants.

The regional forecasts are available from www.maf.govt.nz/mafnet/publications/wood-availability/.

This report summarises the results of the 13 regional forecasts to provide national forecasts.

1 Forest areas reported in this paragraph are from the *National Exotic Forest Description (NEFD) as at 1 April 2008* (MAF, 2009a).

FIGURE 1.1: NEW ZEALAND RADIATA PINE AREA BY CLASS DISTRIBUTION USED IN THE MODELLING[1], IN 2008



Note

1 The areas used in the modelling are lower than reported in the *NEFD as at 1 April 2008* report. Small-scale owners' areas (apart from the investment syndicates) were reduced by 15 percent and some overmature area was also removed. These area reductions are explained in more detail in the sections on Data and Assumptions, and in individual regional wood availability forecast reports.

The forecasts show the range of harvest volumes potentially available from the planted forest estate of both large and small-scale growers. The forecasts are supply-based, but do incorporate harvesting intentions of the larger-scale owners out to 2015.

In utilising these forecasts, users need to recognise that market conditions will be the ultimate determinant of harvesting levels at any particular point in time.

The forecasts indicate that the availability of radiata pine from the New Zealand forest estate will increase over the next 15 years. While the forecasts show increasing wood availability during this period, it is important to recognise that short-term fluctuations are likely due to changes in market conditions.

There are two clear phases to the increase in national radiata pine wood availability:

1. Between 2009 and 2012 there is an increase in potential wood availability from the current harvest level of 18 million cubic metres (year ended March 2009) to around 24 million cubic metres per year. Most of this increase comes from the increasing harvest intentions of large-scale owners, particularly in the Central North Island and Northland. Exactly when this increase in wood availability gets translated into increased harvesting levels will be driven by market conditions and the management decisions of forest owners.

2. Between 2015 and 2025 there is the potential for larger increases in wood availability. Wood availability is forecast to increase rapidly leading into the 2020s, with availability lifting to levels of up to 35 million cubic metres per year from the early 2020s. Most of this increase in availability will come from small-scale forest growers who established forests during the 1990s. The actual timing of the harvest from these forests will depend on market conditions and the decisions of a large number of small-scale owners.

TABLE 1.1: LIST OF WOOD SUPPLY REGIONS AND FORECAST DETAILS

REGION	RELEASE DATE	FORECAST PERIOD	AREA BASED ON NEFD AS AT
Northland	Feb 2009	2007–2040	2007
Auckland	Oct 2008	2007–2040	2007
Central North Island	May 2008	2006–2040	2006
East Coast	Oct 2008	2005–2040	2005
Hawkes Bay	Sep 2008	2005–2040	2005
Eastern Southern North Island	May 2008	2006–2040	2006
Western Southern North Island	May 2008	2006–2040	2006
Nelson	Sep 2006	2005–2040	2005
Marlborough	Sep 2006	2005–2040	2005
West Coast	Jun 2008	2006–2015	2006
Canterbury	Feb 2008	2005–2040	2005
Otago	May 2008	2005–2040	2005
Southland	May 2008	2005–2040	2005

Figure 1.2 shows historic harvest levels from 1995 to 2008 and then the forecast[2] wood availability through to 2025. The graph shows an overall trend of increasing harvest levels between 1995 and 2008; but fluctuations have occurred in response to market conditions such as log and lumber prices, shipping costs and movements in exchange rates.

Separate forecasts have been produced for large-scale owners (owning 1000 hectares or more) and small-scale owners. For radiata pine, the large-scale owners' forests are able to supply an annual sustainable volume of around 20 to 22 million cubic metres of logs. Between 2009 and 2015, the small-scale owners' forests have the capacity to provide an additional 3 to 4 million cubic metres per year. After 2015 and leading into the 2020s, the potential wood available from the small-scale owners forests increases up to 15 million cubic metres per annum.

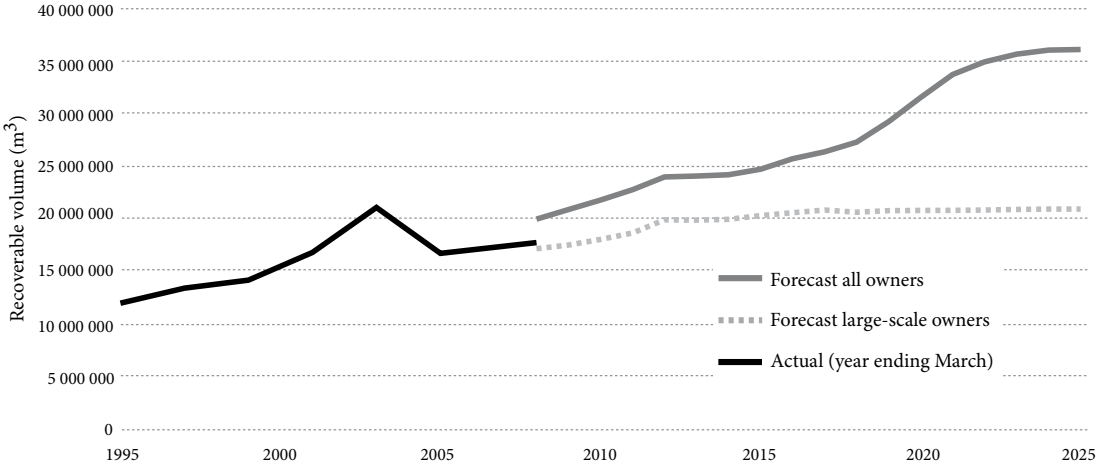
There are different levels of certainty associated with forecast wood availability from each forest ownership segment. The volumes forecast from large-scale owners' forests, while subject to change because of changes in harvest intentions or other factors, have greater certainty than forecasts from the small-scale owners' forests. Not only are the harvest intentions from small-scale owners less certain, the resource description is also generally likely to be less accurate.

Ultimately, market conditions and logistical constraints (availability of logging crews and equipment, availability of roading contractors, engineers and planners, transport capacity, and wood processing capacity) will determine how quickly the additional wood availability from small-scale owners' forests can be harvested.

Much of the post-1989 forest available for harvest after 2015 is contained in smaller blocks which are geographically dispersed. These blocks will be more expensive to log than the existing large contiguous forests that have both scale and existing roading and other infrastructure already in place. Forests that are able to provide lower delivered log costs are likely to be harvested in preference to forests which are more expensive to harvest.

2 The forecast scenario shown in this graph assumes total wood availability is non-declining until 2034. Large-scale owners' availability is at the owners' stated intention until 2015 and then non-declining. For further details on the forecast methodology see scenario section.

FIGURE 1.2: HISTORIC HARVESTING AND FORECAST WOOD AVAILABILITY (RADIATA PINE ONLY)



Some forests may not be harvested. For instance forests on steep terrain, distant from processing plants/ports, small in size or without existing roads may be uneconomic to harvest if logging and transport costs are higher than the market value of the forests' recoverable log volume. A further unknown is the extent to which the Emissions Trading Scheme (ETS) could impact future harvesting decisions. Forest owners who enter their forests into the ETS may decide to lengthen the age that they harvest their forests; or with sufficiently high prices for emission units could decide not to harvest.

Some owners will be motivated to harvest early while others may decide to grow their forests on longer. It is therefore likely that the harvesting of post-1989 forests will be spread out over a longer period than would be the case if the forests were harvested at a fixed rotation age.

In the latter part of the forecast period (post-2034) the total harvest is projected to decline. This is in line with the age structure of the resource. The timing (and level) of decrease will depend on the rate at which post-1989 forests are harvested. It will also depend on whether substantial new planting resumes. The scenarios reported here do not include any new land planting.

Readers who intend using the wood availability forecast for planning or investment decisions are urged to thoroughly review the forecast, or to engage the services of a professional forestry consultant who is able to interpret the forecasts in the context of specific planning or investment decisions.

SCENARIOS 2

These forecasts show the range of harvest volumes potentially available from the planted production forests for the period 2008–2040. Individual forecasts have already been published for 13 wood supply regions across New Zealand.

The wood availability forecasts are based on each region's forest resource and the forecasting assumptions described later in this report. The forecasts have been developed to incorporate the harvesting intentions of the large-scale[3] forest owners in each region.

The forecasts incorporate the views of each region's forest managers and consultants. This feedback was critical for ensuring that the forecasts represent a realistic range of future wood availability scenarios.

The national forecasts in this report have been produced by summing the 13 regional forecasts.

Five scenarios have been modelled to indicate the potential range of future wood availability. A key issue is the timing of harvesting by the small-scale forest owners. The timing will be 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.

The scenarios indicate that there are many different ways the forest estate in New Zealand could be harvested. It needs to be recognised that forests are managed to maximise the benefits to the enterprise that owns them. Each enterprise has its own harvest strategy based on the owners' objectives, market conditions and the forest estate that it owns or manages. Any change in harvesting strategies by forest owners will affect the age-structure and maturity of the forests it owns. This in turn feeds back directly into future wood availability.

Different levels of uncertainty are associated with the wood availability from each component of the estate. The volumes forecast from the large-scale owners' forests – although subject to change because of changes in markets, costs, harvest intentions or changes in the resource description (areas and yields) – have greater certainty than those forecast from the small-scale owners' estate. Not only are harvest intentions less clear for small-scale owners, the resource description is generally likely to be less accurate also.

SCENARIOS FOR RADIATA PINE

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

To ensure the scenarios used in this analysis are reasonable, they were developed in consultation with the National Exotic Forest Description (NEFD) Steering Committee; feedback was also received from major forest owners and consultants in each wood supply region.

SCENARIO 1: HARVEST ALL FOREST AT AGE 30

All owners are assumed to harvest their forests at age 30[4]. This scenario shows the potential future harvest in any given year based on the area of radiata pine forest that reaches age 30 in that year.

SCENARIO 2: LARGE-SCALE OWNERS HARVEST AT STATED INTENTIONS, SMALL-SCALE OWNERS HARVEST FOREST AT AGE 30

Large-scale owners' wood availability is assumed to be at stated harvest intentions until 2015[5]. After 2016, the large-

3 For the purposes of these forecasts, large-scale owners are generally those with 1000 hectares of forest or more in a region. Exceptions are the forests managed by investment syndicates such as Forest Enterprises Ltd and Roger Dickie NZ Ltd. These have been modelled on the same basis as the small-scale owners, because the majority of these forests were planted over the same period, that is, between 1992 and 2000.

4 The Central North Island scenario assumes that all forest is harvested at age 28.

5 Years are assumed to be calendar years: for example, 2009 indicates the year to 31 December 2009.

scale owners' wood availability is not allowed to decrease in the model. Small-scale owners are assumed to harvest forest at age 30.

› SCENARIO 3: NON-DECLINING YIELD – TARGET ROTATION 30 YEARS

Large-scale owners' wood availability is assumed to be at stated harvest intentions (as for scenario 2). The total wood availability of radiata pine from the region is constrained to be non-declining in perpetuity.

› SCENARIO 4: SPLIT NON-DECLINING YIELD – TARGET ROTATION 30 YEARS

This is the same as scenario 3 except that the total wood availability of radiata pine from the region is allowed to step down from 2034 (at the end of the current rotation). Thereafter, a reduction is permitted in the model.

› SCENARIO 5: TARGET ROTATION AGE VARIATIONS

This is similar to scenario 4 except target rotation ages of 28 and 32 years are also evaluated.

»» DISCUSSION OF SCENARIOS

With the exception of scenario 1, the small-scale forest owners have been modelled separately from the large-scale owners. Future harvesting from the small-scale owners is generally less certain than for larger-scale owners.

In scenarios 1 and 2 (Figures 2.1A and 2.1B respectively), forests owned by small-scale owners are assumed to be harvested at age 30 years. In the case of scenario 1 all forests (large and small-scale) are harvested at 30 years. These two scenarios show the "potential" availability of mature forest in any given year, directly reflecting the area of forest in each age-class in New Zealand. For practical reasons already described, it is unlikely that future harvesting would occur like this. These two scenarios simply show the potential magnitude of harvesting under favourable market conditions in any given year.

Scenarios 3 to 5 (Figures 2.1C, 2.1D and 4.12 respectively) are based on yield regulation. Under these scenarios, future harvesting 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. Yield regulation provides a more orderly harvesting volume profile that takes into account, to some extent, logistical and market constraints.

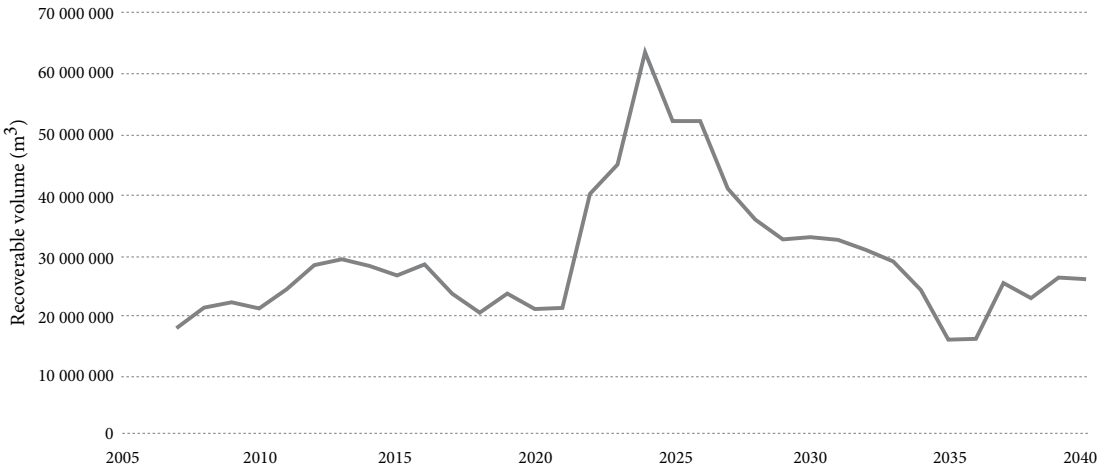
These scenarios avoid the large year-to-year fluctuations seen in scenario 1. A fundamental property of the forests in New Zealand is the large area of forests established during the 1990s, particularly in the period 1992 to 1998. Scenarios 4 and 5 allow for the harvesting of these forests by applying a non-declining yield constraint for the period 2008 to 2034. Then once the "bulge" of forests planted during the 1990s has been harvested, the model allows the volume to decline again.

The main limitation of scenarios 3 to 5 is that log prices and other market factors are significant determinants of harvesting in any given year. When log prices increase, harvesting will generally increase; when log prices fall, the level of harvesting will generally fall. It is beyond the scope of this analysis to predict future log prices.

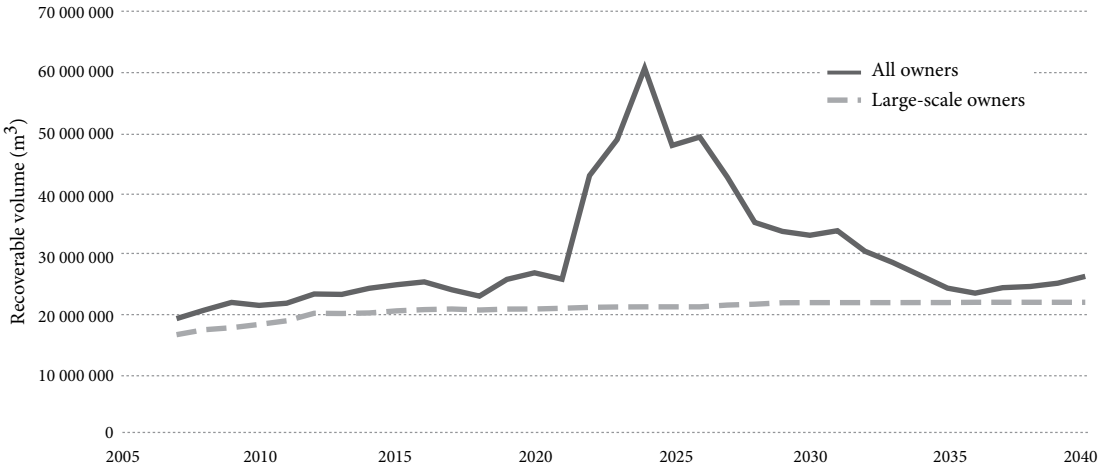
Figure 2.1 shows results from the sequence of models (scenarios) that is presented throughout this report.

FIGURE 2.1: RESULTS FROM THE SEQUENCE OF WOOD AVAILABILITY SCENARIOS PRESENTED IN THIS REPORT FOR RADIATA PINE (VOLUMES FROM CLEARFELLING ONLY)

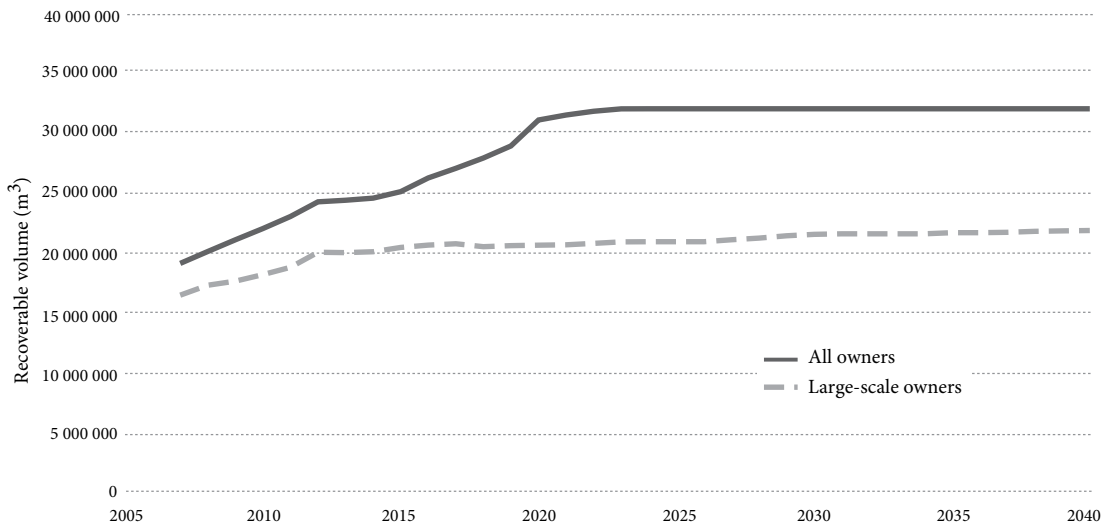
2.1A: SCENARIO 1 EXAMPLE: HARVEST ALL FOREST AT AGE 30



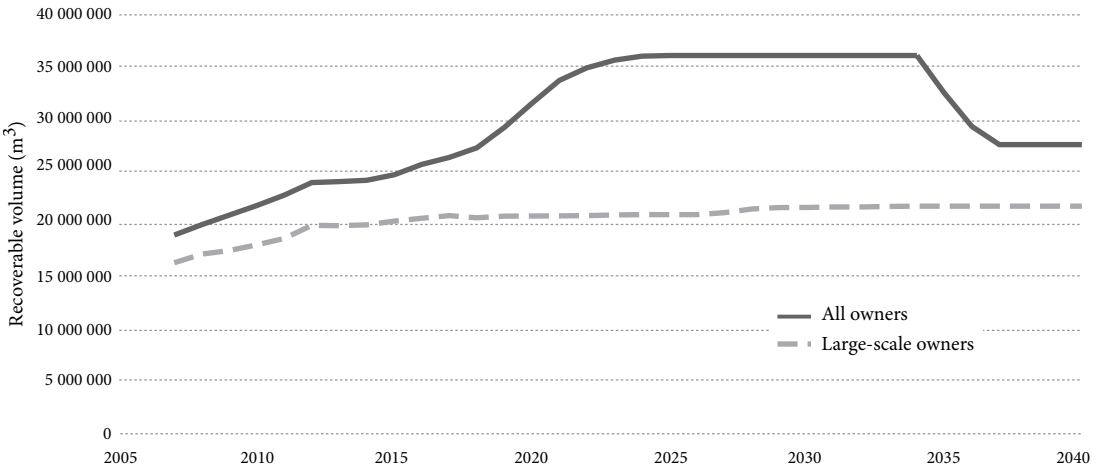
2.1B: SCENARIO 2 EXAMPLE: LARGE-SCALE OWNERS HARVEST AT STATED INTENTIONS, SMALL-SCALE OWNERS HARVEST AT AGE 30



› 2.1C: SCENARIO 3 EXAMPLE: NON-DECLINING YIELD WITH TARGET ROTATION 30 YEARS



› 2.1D: SCENARIO 4 EXAMPLE: SPLIT NON-DECLINING YIELD WITH TARGET ROTATION 30 YEARS



DATA AND ASSUMPTIONS 3

METHOD USED TO OBTAIN FOREST AREAS

Area was obtained from the latest *NEFD* data available at the time the forecasts were being developed for each region (see Table 1.1). The small-scale owners' estate (apart from that of the investment syndicates) was reduced by 15 percent. This was done because the area in this ownership category is often reported on the basis of gross area rather than net stocked area.

In addition, some area had to be reallocated between croptypes for the following reasons:

- One company provided data in the NEFD survey based on current silvicultural status rather than their intentions (that is, areas that were intended to be pruned were left in the unpruned croptype until the pruning had been done).
- Some companies use a different pruned/unpruned definition for the NEFD reporting than they do for harvest planning. This required areas to be moved from the pruned croptype to the unpruned croptype as follows:
  - 3300 hectares in Canterbury;
  - 1500 hectares in Hawkes Bay;
  - 1000 hectares in the Western Southern North Island.

LARGE-SCALE OWNERS' HARVEST INTENTIONS

Large-scale owners were asked to provide details of actual and planned harvest volume by log grade and area from 2005 to 2015. These harvest intention values were then included at the beginning of the forecasts, to provide the most realistic wood availability forecasts over this period.

METHOD TO DEVELOP YIELD TABLES

New yield tables were developed for each region in the following manner:

- Large-scale owners provided yield tables for their estate.
- These were averaged on an area-weighted basis to get regional yield tables for each croptype.
- Yield tables for old (planted before 1990) radiata pine were then calibrated to match the harvest intentions data provided by large-scale owners; that is, the assumption is that the harvest intentions data is the most accurate information available. This is because it is based predominantly on detailed inventory and on other known factors that affect merchantable volume.
- Yield tables for young radiata pine croptypes (planted in 1990 and later) were also calibrated in consultation with large-scale owners.
- The yield tables developed for the large-scale owners' estate were also applied to the small-scale owners' estate.

ASSUMPTIONS

Although the wood availability forecasts for each region are based on the same general process, assumptions for each region vary depending on regional conditions and advice provided by local forest managers and consultants.[6]

NEW LAND PLANTING

No new land planting has been included in the forecasts.

REPLANTING

From 2008 on, all area in the large-scale owners' estate is assumed to be replanted (with a regeneration lag of 1 year) apart from three regions which allow for some deforestation (at levels intended at the time the regional forecasts were undertaken). In some regions, a small level of deforestation is assumed for the small-scale growers' estate. This is summarised in Table 3.1.

SPECIES

The default assumption in the model is that area is replanted into the same species. Some exceptions for large-scale owners are listed in Table 3.2.

6 Forecasts for the West Coast were developed using a different approach, however. A single forecast for 2007 to 2015 was compiled by combining the harvesting intentions of large-scale owners with estimated annual volumes from small-scale owners. West Coast forecast volumes (extended until 2040) are included in all results presented in this report.

TABLE 3.1: AREA ASSUMED DEFORESTED AFTER HARVESTING (FROM 2008 ON)

REGION	LARGE-SCALE OWNERS (HECTARES)	SMALL-SCALE OWNERS % OF HARVESTED AREA NOT REPLANTED
Northland	0	0
Auckland	0	0
Central North Island[1]	0	10
East Coast	0	0
Hawkes Bay	4 300	20
Eastern Southern North Island	0	10
Western Southern North Island	0	10
Nelson	1 900	0
Marlborough	0	0
Canterbury	4 800	0
Otago	0	0
Southland	0	0

Note
1 When the Central North Island forecasts were produced, it was assumed that the announced liabilities for deforestation of pre-1990 forests would mean little deforestation would occur from 2008. Within the Central North Island report, an additional deforestation scenario was modelled to show the impacts of deforestation on future wood availability. For further information see: http://www.maf.govt.nz/mafnet/publications/wood-availability/central-north-island/page-03.htm#P190_21555

TABLE 3.2: PERCENTAGE OF AREA IN THE LARGE-SCALE OWNERS' ESTATE ASSUMED TO BE REPLANTED INTO A DIFFERENT SPECIES FOLLOWING HARVEST

REGION	RADIATA PINE TO DOUGLAS-FIR (%)	DOUGLAS-FIR TO RADIATA PINE (%)
Northland	0	0
Auckland	0	0
Central North Island	0	0
East Coast	0	100
Hawkes Bay	0	100
Eastern Southern North Island	0	100
Western Southern North Island	0	100
Nelson	0	100
Marlborough	0	0
Canterbury	0	0
Otago	13	0
Southland	0	0

› REGIME

Area in unpruned croptypes is replanted back into an unpruned croptype following harvest. In some regions, there is an intention for less pruning to be done in the future. Consequently, some area in pruned croptypes is replanted into an unpruned croptype following harvest (see Table 3.3).

› OVERMATURE STANDS

In most regions, some area in older age classes (greater than rotation length) was removed on the assumption that this area will not be harvested. The area of overmature forest removed was based on advice from large-forest owners and consultants. The overmature age cut-offs are listed in Table 3.4.

TABLE 3.3: PERCENTAGE OF AREA IN PRUNED CROPTYPES THAT IS ASSUMED TO BE REPLANTED INTO AN UNPRUNED CROPTYPE FOLLOWING HARVEST (THE BALANCE OF THE AREA IS ASSUMED TO BE REPLANTED INTO THE PRUNED CROPTYPE)

	LARGE-SCALE ESTATE – PRUNED		SMALL-SCALE ESTATE – PRUNED	
REGION	OLD	YOUNG	OLD	YOUNG
Northland	75	50	25	25
Auckland	80	0	0	0
Central North Island	50	0	0	0
East Coast	0	0	0	0
Hawkes Bay	25	10	0	0
Eastern Southern North Island	0	0	25	25
Western Southern North Island	25	0	25	25
Nelson	0	0	0	0
Marlborough	0	0	0	0
Canterbury	0	0	0	0
Otago	0	0	0	0
Southland	0	0	0	0

TABLE 3.4: AGE (YEARS) CUT-OFF USED TO DEFINE OVERMATURE AREA

REGION	LARGE-SCALE ESTATE	SMALL-SCALE ESTATE
Northland	>35	>35 and 50% of 31–35
Auckland	na	na
Central North Island	>40	>40
East Coast	>40	>40
Hawkes Bay	>40	>40
Eastern Southern North Island	>40	>35
Western Southern North Island	>35	>35
Nelson	na	>35
Marlborough	na	>33 and 42% of 30–33
Canterbury	na	>40
Otago	>40	>40 and 25% of 31–40
Southland	>40	>40 and 30% of 31–40

Note
na = not applicable.

NEW ZEALAND FORECAST RESULTS

4

SCENARIO 1: HARVEST ALL FOREST AT AGE 30

In this scenario, all forests are harvested at age 30 (apart from the Central North Island which uses a 28-year rotation). The scenario shows the "pure" (that is, unconstrained) availability of wood from New Zealand's planted forests. This means wood availability reflects the age-class distribution. Figure 4.1 shows the age-class distribution of radiata pine in New Zealand obtained by summing the age-class distribution as at 31 March 2008 from each regional model[7].

Figure 4.2 shows the wood availability. The low point at 2018 (in Figure 4.2) occurs because of the small area at age 17 (planted in 1991) in Figure 4.1. The high point at 2024 in Figure 4.2 corresponds with the large area at age 14 (planted in 1994) in Figure 4.1.

7 The age-class distribution reflects the assumptions made in each regional model. The areas differ from the *NEFD as at 1 April 2008* (MAF, 2009a), as small-scale owners' areas (apart from the investment syndicates) were reduced by 15 percent and some overmature areas were also removed. Each regional model used the latest NEFD data when the model was developed. Because the regional models were developed over a three-year period, different reference years have been used (2005, 2006 or 2007) depending on when the regional model was produced. Model age-class distributions as at 31 March 2008 have been used to provide consistent data to aggregate into a national overview.

SCENARIO 2: LARGE-SCALE OWNERS HARVEST AT INTENTIONS, SMALL-SCALE OWNERS HARVEST FOREST AT AGE 30

In this scenario, large-scale owners harvest in line with their stated intentions, and small-scale owners harvest forest at age 30.

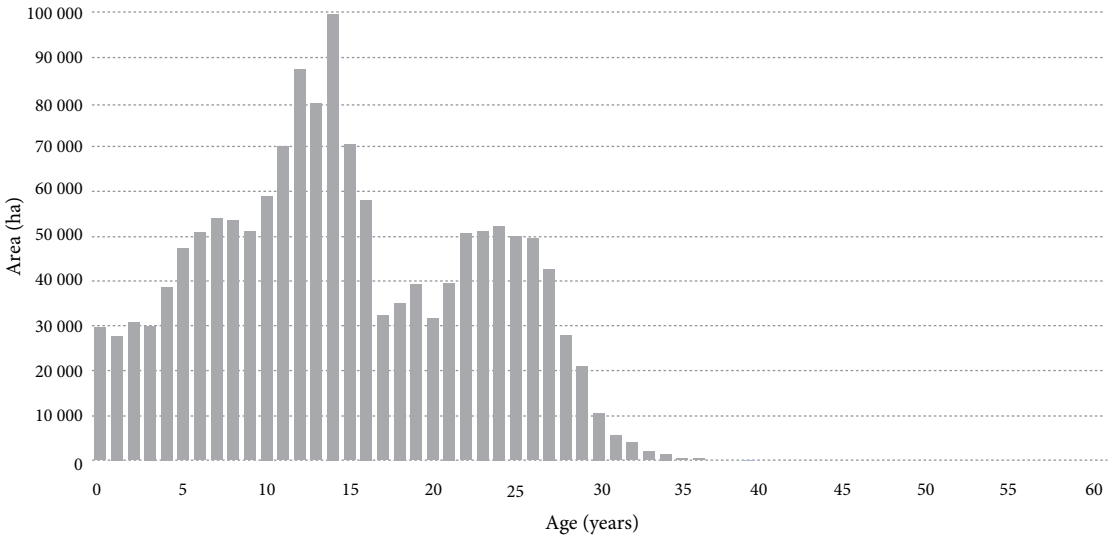
LARGE-SCALE OWNERS

The total area included in the regional models for large-scale owners is 1 004 000 hectares. The age-class distribution of the large-scale owners' estate (Figure 4.3) is uneven. There are relatively large areas aged between 22 and 26 years (planted between 1982 and 1986) but much less area aged 15 to 18 years (planted between 1990 and 1993). The area at age 0 was awaiting replanting as at 31 March 2008 (that is, area to be replanted in the 2008 planting season).

In this scenario the availability of wood from large-scale owners is based on stated harvest intentions[8] through to

8 Log grade minimum small end diameters are: Pruned 35 cm; Unpruned sawlog 20 cm; Pulplog 10 cm.

FIGURE 4.1: AGE-CLASS DISTRIBUTION OF NEW ZEALAND RADIATA PINE AS AT 31 MARCH 2008 – ALL OWNERS



2015. A reduction is permitted in the model between 2015 and 2016. Thereafter (in most regional models) the availability is constrained to be non-declining with a target rotation age of 30 years. The wood availability from large-scale owners (Figure 4.4) is forecast to increase relatively rapidly through to 2012, rising to 20 million cubic metres per year in 2012, and then only increase gradually to 22 million cubic metres per year to 2029.

FIGURE 4.2: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 1 – CLEARFELL VOLUMES

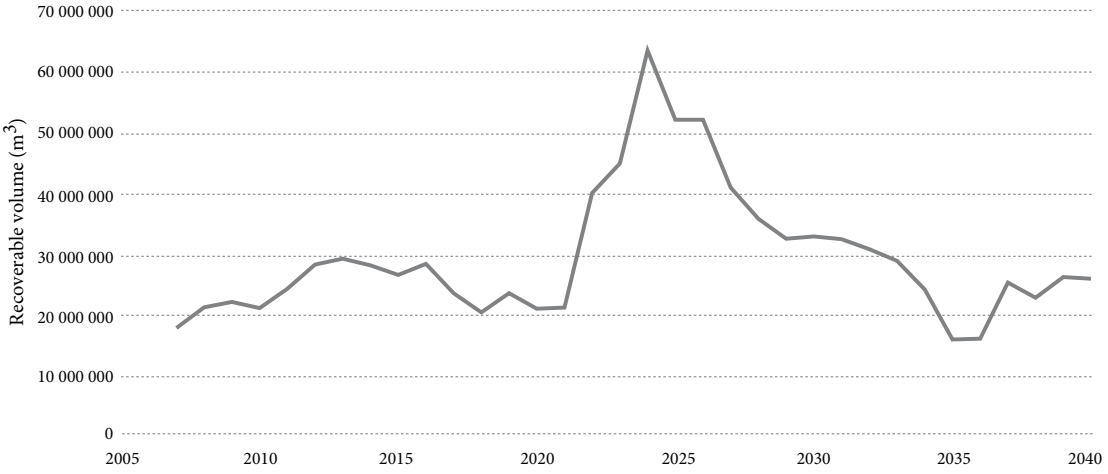


FIGURE 4.3: AGE-CLASS DISTRIBUTION OF THE NEW ZEALAND RADIATA PINE ESTATE AS AT 31 MARCH 2008 – LARGE-SCALE OWNERS ONLY

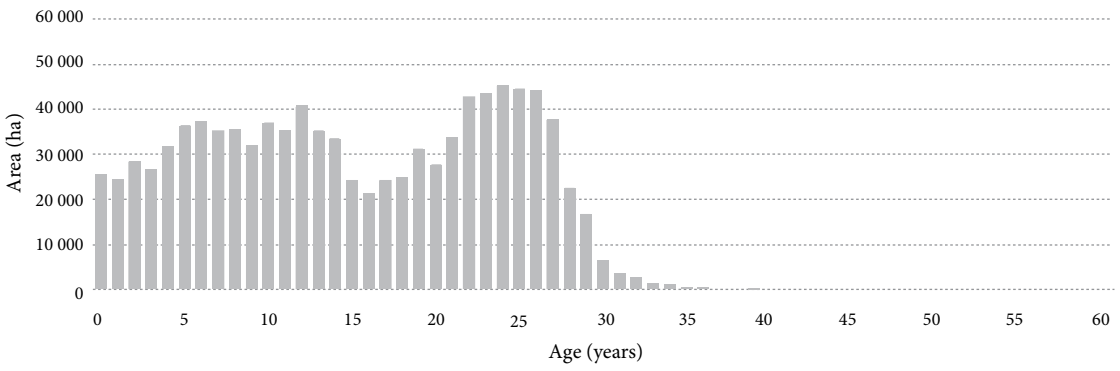


FIGURE 4.4: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 2 – LARGE-SCALE OWNERS ONLY, CLEARFELL VOLUMES

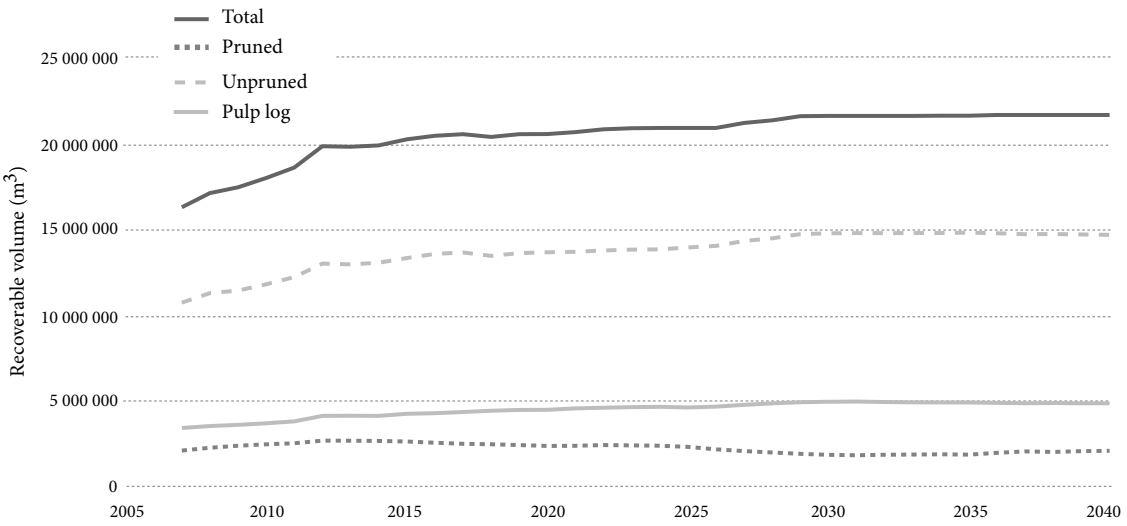


TABLE 4.1: CHANGES IN LARGE-SCALE OWNERS' HARVEST INTENTIONS BY REGION (CUBIC METRES) ANNUAL CHANGES ARE SHOWN BY YEAR (FOR EXAMPLE, 2009 = CHANGE FROM 2008 TO 2009)

	2009 (000 M³)	2010 (000 M³)	2011 (000 M³)	2012 (000 M³)	2013 (000 M³)	2014 (000 M³)	2015 (000 M³)	2008–2015 (000 M³)
Northland	228	269	348	325	22	–17	63	1 238
Auckland	–42	28	48	–48	105	1	0	92
Central North Island	103	220	530	950	16	–52	256	2 023
East Coast	147	132	84	22	–63	8	30	360
Hawkes Bay	–9	–68	–204	–31	–27	–43	–4	–386
Eastern Southern North Island	–73	5	–2	–2	–57	16	15	–98
Western Southern North Island	–43	26	–69	–54	–4	–10	4	–150
Nelson	–62	29	21	34	–122	49	0	–51
Marlborough	18	–73	–24	–45	130	15	16	37
West Coast	–20	4	0	0	0	0	0	–16
Canterbury	–2	3	–101	1	5	6	10	–78
Otago	92	–27	21	37	14	120	–50	207
Southland	2	14	–43	51	–51	–13	16	–24
New Zealand	**339**	**562**	**609**	**1 240**	**–32**	**80**	**356**	**3 154**

Based on the harvest intentions of large-scale owners, volumes are forecast to increase from 17.1 million cubic metres in 2008 to 20.3 million cubic metres in 2015. The majority of this increase (2.0 out of 3.2 million cubic metres) occurs in the Central North Island (Table 4.1). Other regions that have significant increases in harvest volumes from the large-scale owners are Northland, East Coast and Otago. Decreases are forecast for all other regions apart from Auckland and Marlborough.

› SMALL-SCALE OWNERS

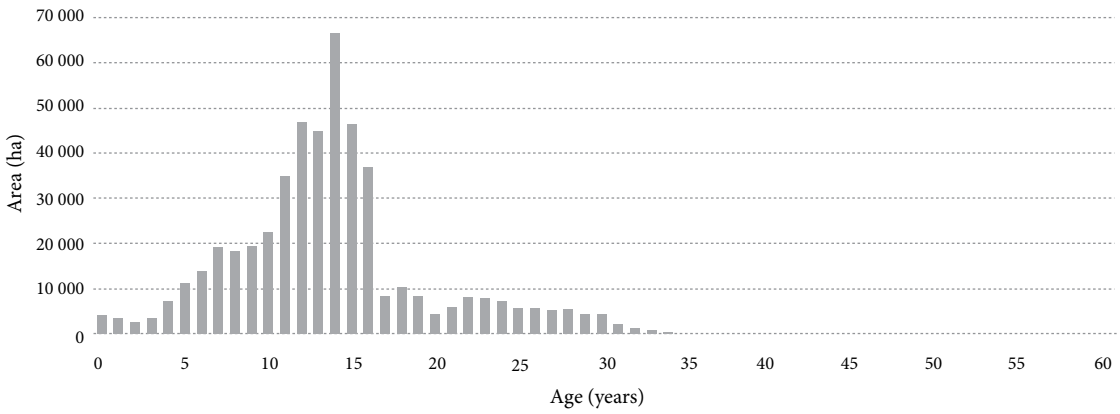
The age-class distribution of the small-scale owners' estate (Figure 4.5) is very irregular with over 30 000 hectares in each of ages 11 to 16 years (planted in 1992 to 1997) and less area in all other age classes. The key issue is how to forecast the wood availability from this estate. In particular, will the large area in ages 11 to 16 be harvested:

- at a fixed rotation age (scenario 2);
- spread over many years (scenario 3);
- spread over an intermediate number of years (scenario 4).

› COMBINED ESTATE

The wood availability from all owners is presented in Figure 4.6. The wood availability from the large-scale owners' estate is the same as presented in Figure 4.4. In this scenario (scenario 2) all forest in the small-scale owners' estate is assumed to be harvested at age 30. The fluctuations in the total volume harvested reflect the variation in the age-class distribution of the small-scale owners' estate. The large increase in volume from 2022 occurs when the large areas from the small-scale owners' estate in young age-classes (planted from 1992) is harvested.

FIGURE 4.5: AGE-CLASS DISTRIBUTION OF THE NEW ZEALAND RADIATA PINE ESTATE AS AT 31 MARCH 2008 – SMALL-SCALE OWNERS ONLY



Fluctuations in harvest volumes of the magnitude shown between 2022 and 2025 in Figure 4.6 will not occur because of market and logistical constraints. For instance, there would be insufficient harvesting and transport capacity to harvest such large increases in volumes.

SCENARIO 3: NON-DECLINING YIELD – TARGET ROTATION 30 YEARS

The third scenario assumes a non-declining yield, with a target rotation age of 30 years. Figure 4.7 indicates that when the small-scale owners' estate is harvested to complement the large-scale owners' estate, the total volume (radiata pine) has the potential to increase substantially. The potentially available volume increases to over 30 million cubic metres per year from 2020.

This scenario is similar to the base case scenario adopted in the *2000 NEFD Wood Supply Forecasts (*MAF, 2000). The average rotation age[9] for the large-scale owners' estate is close to the target of 30 years. However, the scenario results in the small-scale owners' estate being harvested at rotation ages that differ markedly from 30 years (Figure 4.8).

9 National average clearfell age is calculated on an area-weighted basis from the results of the regional models.

FIGURE 4.6: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 2 – COMBINED ESTATE, CLEARFELLING VOLUMES

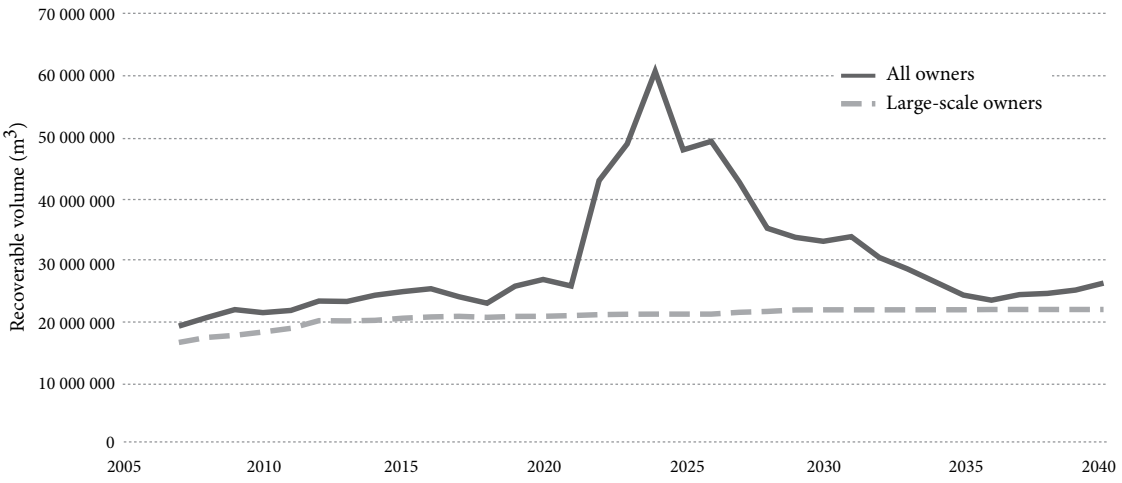


FIGURE 4.7: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 3 – CLEARFELLING VOLUMES

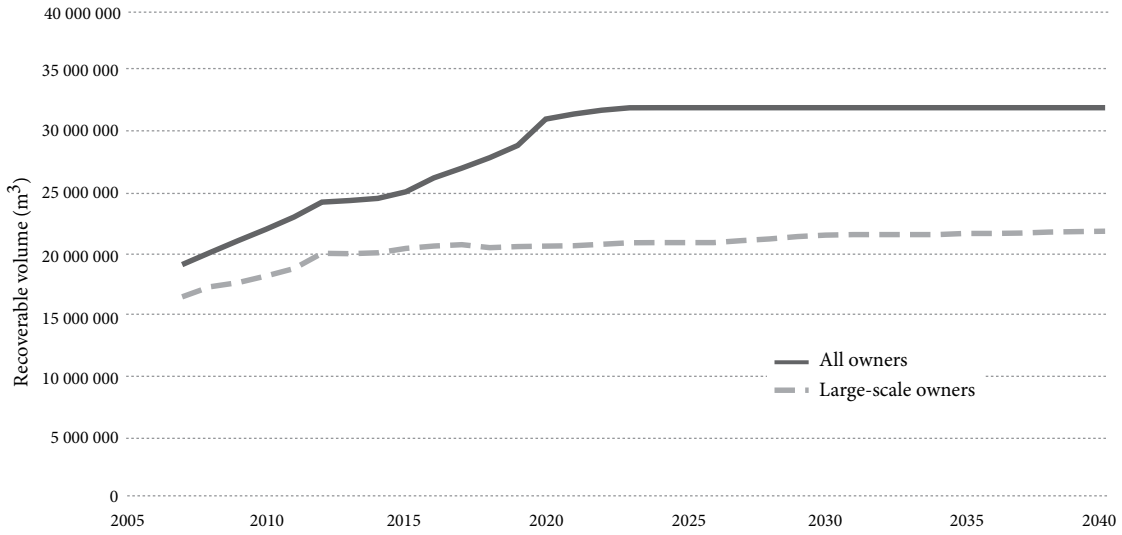
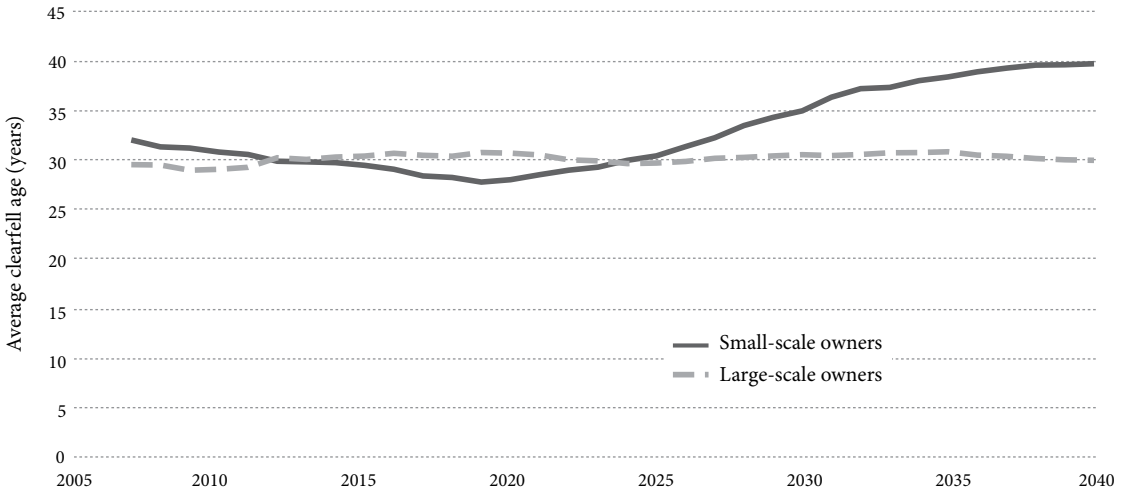


FIGURE 4.8: AVERAGE RADIATA PINE CLEARFELL AGE BY OWNERSHIP CATEGORY UNDER SCENARIO 3



SCENARIO 4: SPLIT NON-DECLINING YIELD – TARGET ROTATION 30 YEARS

The fourth scenario is based on a split non-declining yield, with a rotation age of 30 years. This scenario gives a forecast wood availability that is similar to scenario 3 through to 2019 (Figure 4.9). Wood availability increases to over 35 million cubic metres per year from 2022 before reducing to 28 million cubic metres per year from 2037.

The main difference from scenario 3 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. The total volume was constrained in each of the regional models to be non-declining from 2007 to 2034; that is, for the current rotation. Thereafter an annual reduction of up to 10 percent was allowed before the yield was required to be non-declining for the next rotation (from 2037). As a consequence the average clearfell age for small-scale owners stays closer to the target of 30 years than was the case in scenario 3 (Figure 4.10).

The total volume forecast for scenario 4 is broken down by log grade in Figure 4.11.

FIGURE 4.9: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 4 – CLEARFELLING VOLUMES

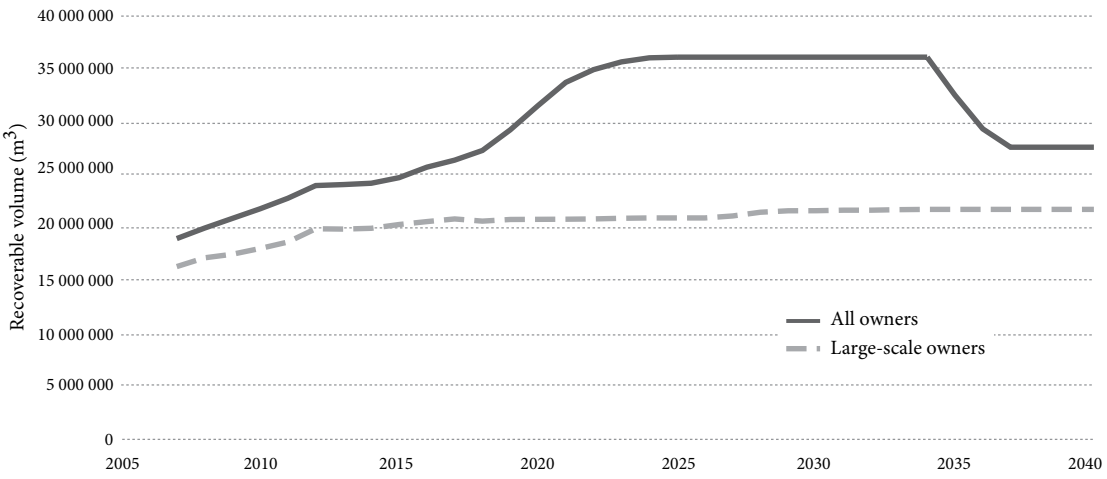


FIGURE 4.10: AVERAGE RADIATA PINE CLEARFELL AGE BY OWNERSHIP CATEGORY UNDER SCENARIO 4

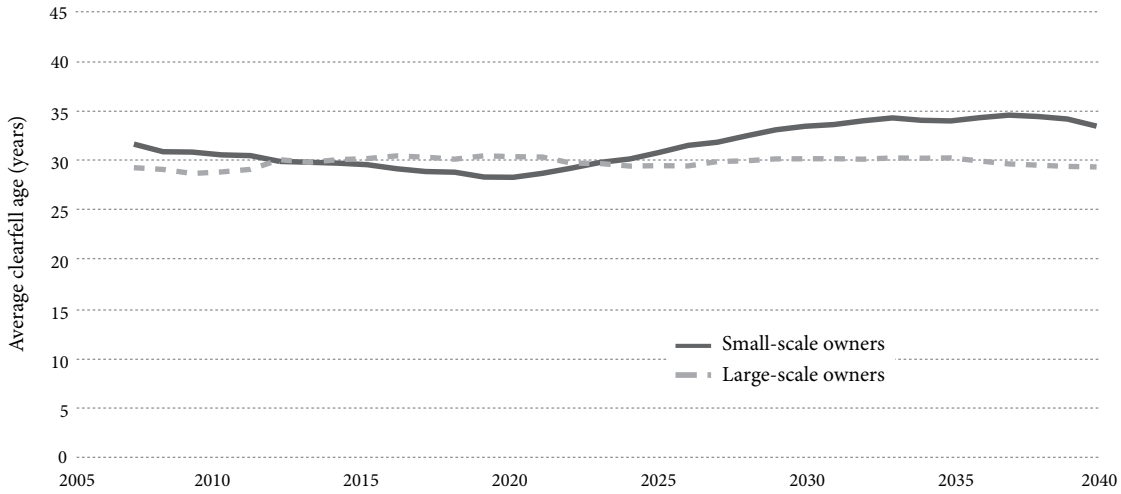
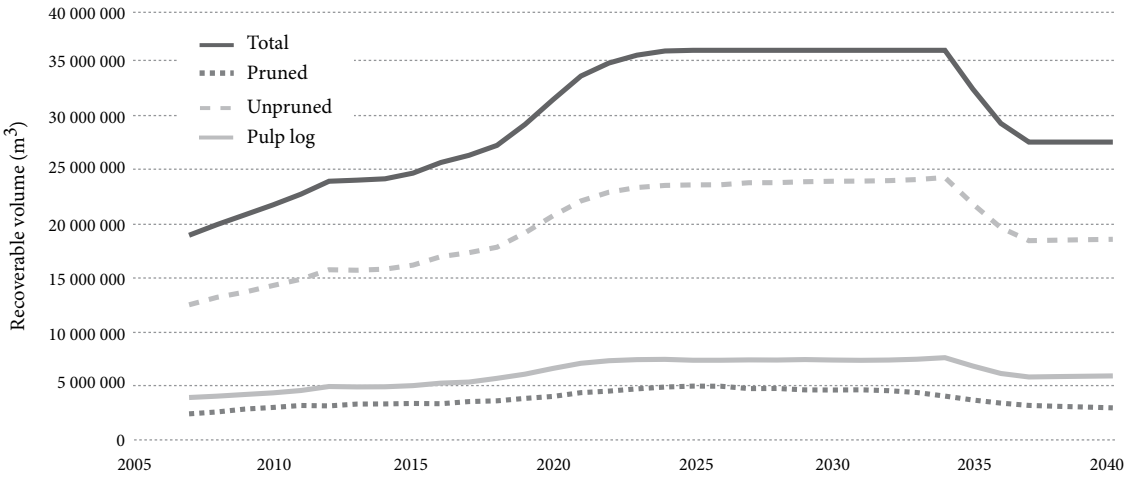


FIGURE 4.11: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 4 BY LOG PRODUCT – CLEARFELLING VOLUMES



SCENARIO 5: TARGET ROTATION AGE VARIATIONS

Different wood availability profiles are generated if target rotation age is changed from 30 years to either 28 or 32 years (Figure 4.12). 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 4.13) between the different target rotation lengths.

Figure 4.12 shows that there is the potential for a significant increase in the New Zealand harvest volumes. However, there is a range of possibilities for the timing of the increase and the level of the potential harvest volume. These possibilities largely arise because of alternative harvest profiles for the small-scale owners' estate (Figure 4.14).

In the scenario with target rotation of 30 years (scenario 4) the harvest volumes of small-scale owners are forecast to increase from 2.8 million cubic metres in 2008 to 15.2 million cubic metres in 2025. The largest increase occurs in the Central North Island followed by East Coast, Northland, Hawkes Bay, western Southern North Island and eastern Southern North Island (Table 4.2).

FIGURE 4.12: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 5 – CLEARFELLING VOLUMES

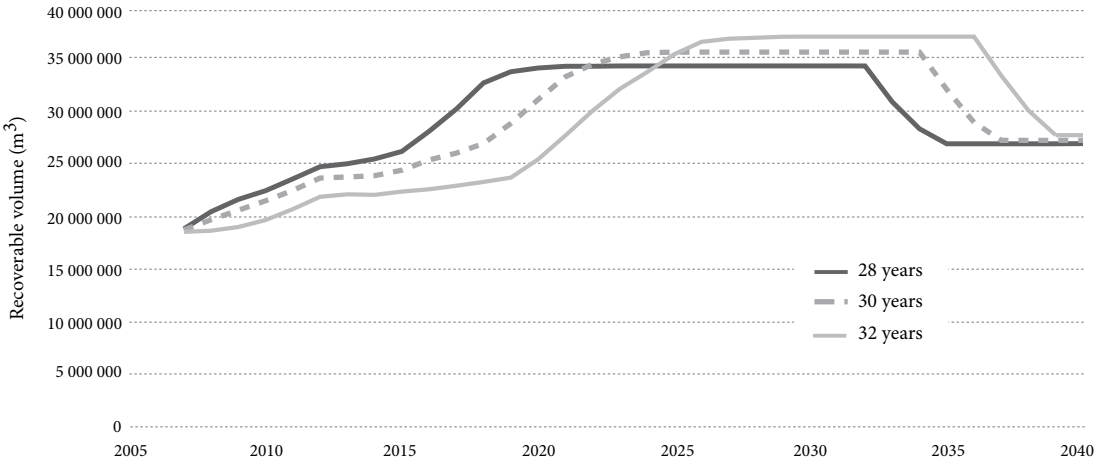


FIGURE 4.13: AVERAGE RADIATA PINE CLEARFELL AGE FOR EACH TARGET ROTATION AGE UNDER SCENARIO 5

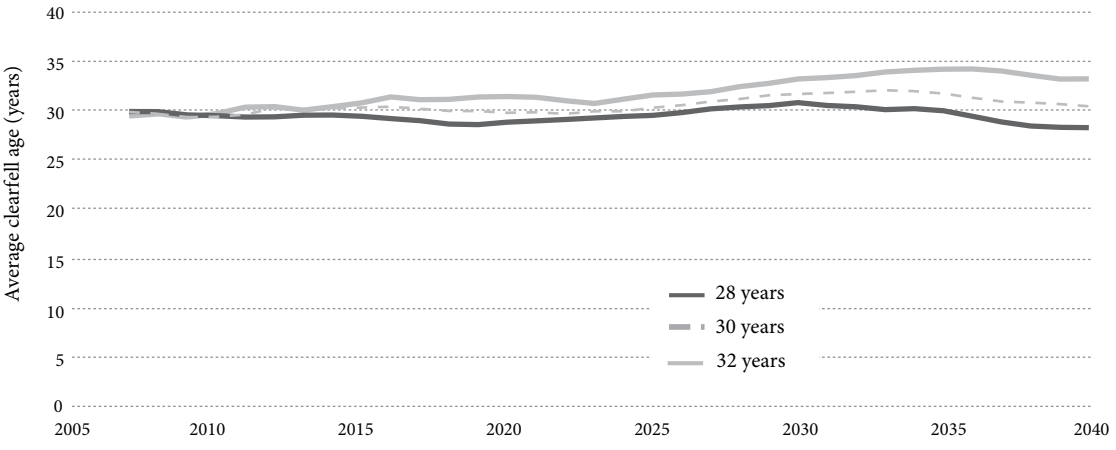


FIGURE 4.14: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 5 – SMALL-SCALE OWNERS ONLY, CLEARFELL VOLUMES

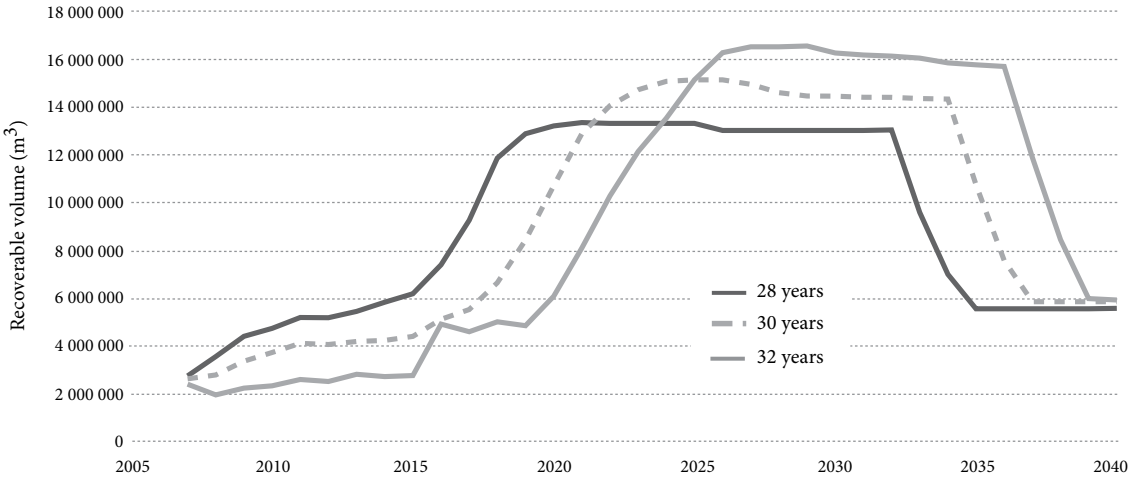


TABLE 4.2: CHANGES IN SMALL-SCALE OWNERS' HARVEST BY REGION BETWEEN 2008 AND 2025

	CHANGE IN VOLUME (000 M³)	AREA IN MODEL (HA)
Northland	1 459	51 000
Auckland	574	19 000
Central North Island	2 396	72 000
East Coast	1 633	63 000
Hawkes Bay	1 297	50 000
Eastern Southern North Island	897	43 000
Western Southern North Island	1 017	58 000
Nelson	788	20 000
Marlborough	731	34 000
West Coast	–7	3 000
Canterbury	514	37 000
Otago	604	31 000
Southland	457	20 000
New Zealand	**12 359**	**500 000**

PRODUCTION THINNING VOLUMES

Potential volumes from production thinning are shown for scenario 4 in Figure 4.15. All volume is from the Central North Island. Production thinning volumes are forecast to be relatively static at between 150 000 to 250 000 cubic metres. These production thinning volumes are at a very low level compared to clearfell volumes.

DOUGLAS-FIR

Wood availability forecasts were developed for each region except Northland and Auckland (where Douglas-fir is not present) and the West Coast (which had limited information when the forecasts were produced). The approach to yield regulation varied by region, depending on the Douglas-fir age-class distribution and whether there was an intention to replant harvested area back into

FIGURE 4.15: NEW ZEALAND RADIATA PINE – VOLUMES AVAILABLE FROM PRODUCTION THINNING UNDER SCENARIO 4

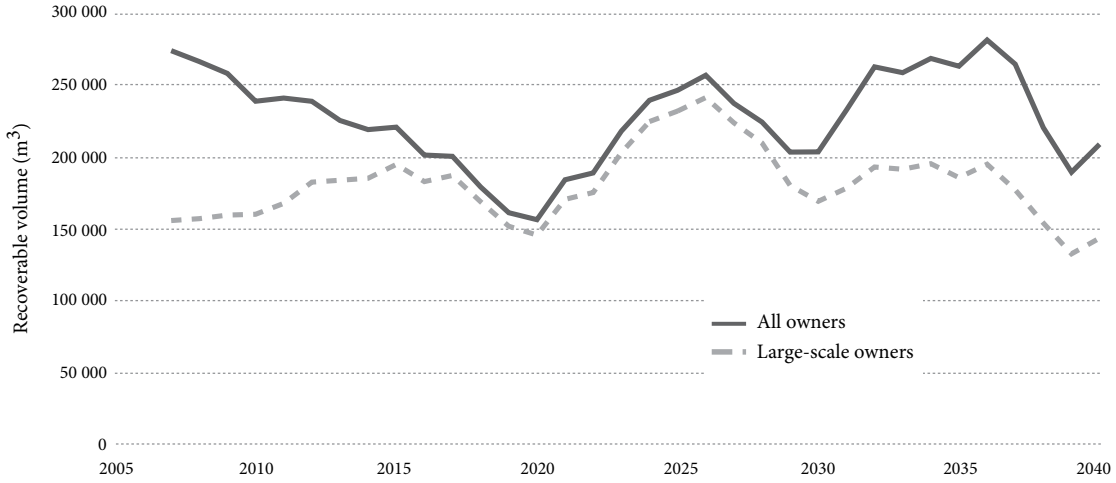
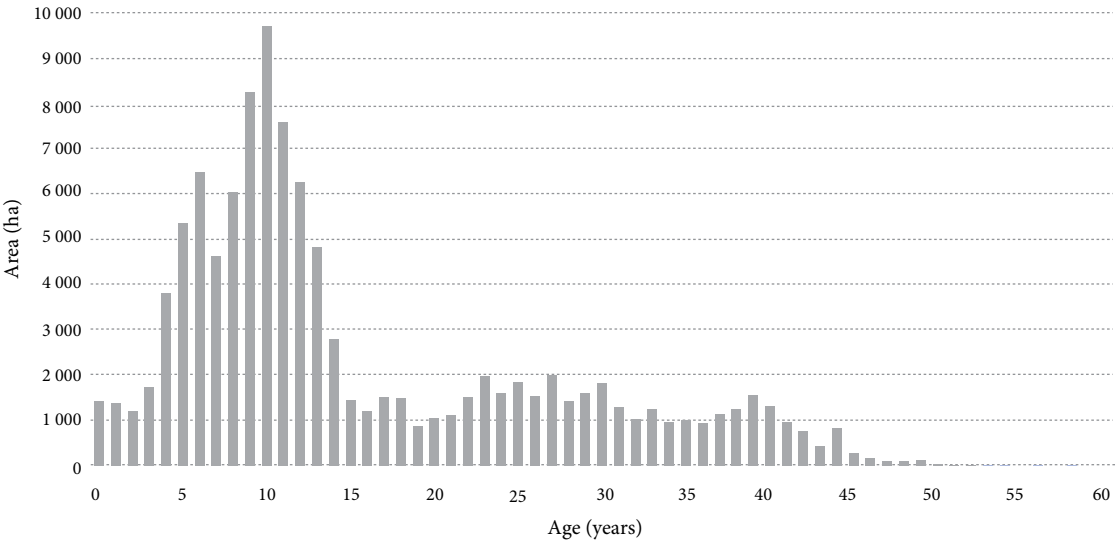


FIGURE 4.16: AGE-CLASS DISTRIBUTION OF NEW ZEALAND DOUGLAS-FIR AS AT 31 MARCH 2008 – COMBINED ESTATE



Douglas-fir. Figure 4.16 shows the national Douglas-fir age-class distribution while Figure 4.17 gives collated forecast results.

The national Douglas-fir wood availability initially decreases from 2007 to 2015. This is followed by a small increase in 2016 with steady availability until about 2023, at which time Douglas-fir wood availability starts to increase more significantly. The increase of 1.9 million cubic metres between 2008 and 2040 occurs mainly in Southland (0.9 million cubic metres) and Otago (0.8 million cubic metres) followed by Canterbury (0.2 million cubic metres). Douglas-fir wood availability decreases by 50 000 cubic metres in the Central North Island during this period.

FIGURE 4.17: NEW ZEALAND DOUGLAS-FIR WOOD AVAILABILITY

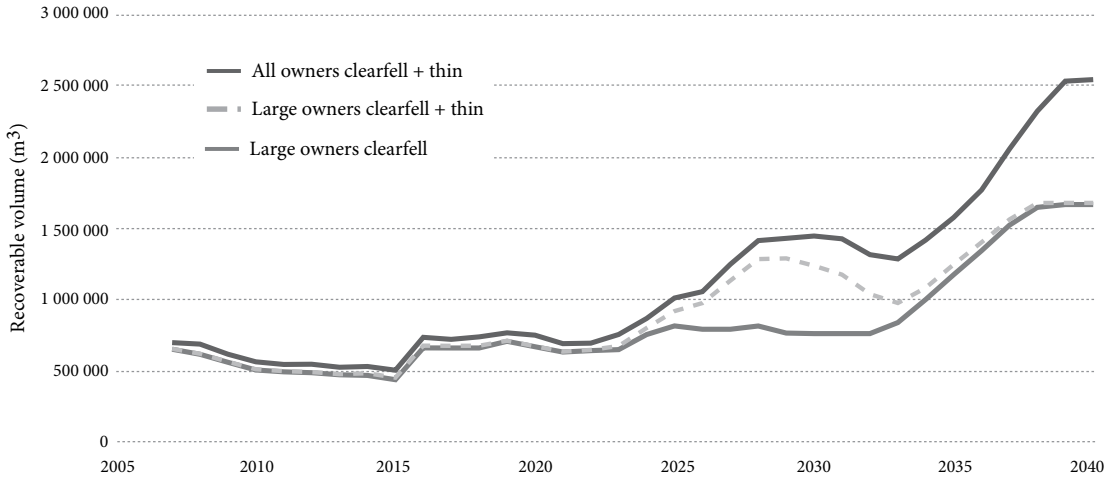


TABLE 4.3: CHANGES IN DOUGLAS-FIR WOOD AVAILABILITY (ALL OWNERS) BY REGION AND TIME PERIOD (CUBIC METRES)

	2008–2015 (000 M³)	2016–2025 (000 M³)	2026–2040 (000 M³)	2008–2040 (000 M³)	AREA IN MODEL (HA)
Central North Island	–51	1	5	–45	22 900
East Coast	–14	0	0	–13	1 600
Hawkes Bay	–23	4	–5	–24	700
Eastern Southern North Island	–48	0	0	–48	700
Western Southern North Island	–24	8	–6	–23	900
Nelson	–16	44	32	59	9 200
Marlborough	–5	68	–38	25	2 000
Canterbury	0	40	173	214	15 000
Otago	–1	205	593	797	29 900
Southland	–1	137	780	916	28 000
New Zealand	**–183**	**507**	**1 534**	**1 858**	**110 900**

ADDITIONAL ANALYSIS 5

The regional forecasts which have been summed to provide these national forecasts were developed over the period 2006 to 2008. Some factors have not been included in the models but may impact future wood availability and/or harvesting decisions. These factors include: the 2008/09 global recession; the future impact of the Emissions Trading Scheme; some forest areas not being economic to harvest; and future afforestation. Some general comments on the impacts of these factors are presented below.

GLOBAL RECESSION

The large-scale forest owners' harvesting intentions were collected on a region-by-region basis as the regional forecasts were produced (Table 1.1). All of these intentions were collected before the effects of the global recession began to be felt in the second half of 2008. The recession led to reduced demand for forestry products in New Zealand's key international markets such as the United States, Australia and Japan and to a lesser extent in other Asian countries. The recession also led to reduced domestic demand as building activity rapidly declined.

Towards the end of 2008 and during 2009, the increase in demand for logs in China coincided with a significant reduction in log shipment costs, leading to an increase in log exports.

Table 5.1 compares the volumes large owners intended to harvest with what these owners actually harvested. Actual harvest volumes in 2007 and 2008 calendar years have been 4 percent and 6 percent lower than what was intended to be harvested. At a regional level, the largest differences for large-scale owners (2007 and 2008 combined) were:

- East Coast – where the actual harvest was 19 percent less than intentions;
- Southern North Island (Western and Eastern combined) – where actual harvest was 17 percent less than intentions; and
- Otago/Southland – where actual harvest was 15 percent less than intentions.

The Central North Island, which produced 43 percent of national harvest volume during this period, had actual harvest volumes that were only 3 percent lower than intentions.

The 2009 calendar year estimates of actual harvesting were not available when this report was published.

IMPACT OF THE EMISSIONS TRADING SCHEME

There is no historical data to quantitatively assess the impacts the ETS will have on future wood availability. Future wood availability will only be impacted by the area of post-1989 forest that enters the ETS. Given the relatively short period the ETS has been in operation and the recent amendments to the ETS legislation, it is too

TABLE 5.1: LARGE-SCALE OWNERS' NATIONAL INTENTIONS COMPARED TO ACTUAL VOLUMES HARVESTED[1]

	LARGE-SCALE OWNERS INTENDED HARVEST VOLUME (RADIATA PINE) (000 M^3)	LARGE-SCALE OWNERS ACTUAL HARVEST VOLUME (RADIATA PINE) (000 M^3)	DIFFERENCE (000 M^3)
2007	16 343	15 623	720
2008	17 172	16 082	1 090

Note
1 Comparison is for December years. Actual volumes are derived from NEFD data.

early to predict what proportion of the post-1989 forest area will ultimately be entered into the ETS.

For those forests that enter the ETS, economic analysis indicates that owners may benefit from longer rotations, changes in silviculture with the possibility that some areas may not be harvested at all.

The impact of the ETS will ultimately be determined by the prices of logs and emission units.

AREA NOT BEING HARVESTED

It is possible that some forests are not harvested where the market value of the crop is exceeded by harvesting and transport costs. This could be the case where forests are small, or located on steep land, or where significant expenditure is required to build roads. During the 1990s significant areas of forests were planted by non-traditional forest owners. Some of these forests have been planted in locations that are going to be costly to harvest. This is likely to become a more significant issue when the 1990s plantings are due for harvesting during the 2020s, and could result in some of this area not being economic to harvest.

In each of the regional models, the area of forest older than the current harvest age was examined. Based on advice from large forest owners and consultants, a proportion of the over-mature area was removed from the modelling where these areas were not expected to be harvested. Details on the area of over-mature forest removed from the modelling can be found in the regional reports.

FUTURE NEW FOREST PLANTING

No future afforestation was assumed in any of the wood availability models. Future afforestation intended for wood supply would increase wood availability from the mid-2030s. The current modelling shows wood availability declining from 2034 after the forests planted during the 1990s area harvested. Any new afforestation would reduce the level of this decline.

ADDITIONAL MODELLING

Subsequent analysis has been undertaken to examine the impact of the following assumptions:

- yield assumptions;
- deforestation;
- reduction in wood availability after 2034.

YIELD ASSUMPTIONS

Yield tables for young croptypes (planted after 1989) generally have higher volumes than yield tables for old croptypes (planted before 1990). A consequence of this is that average clearfell volumes are forecast to increase in the future as the areas planted after 1989 start to be harvested. The effect of this increase in recovered volume per hectare is shown in Figure 5.1.

As a sensitivity analysis, the scenario 4 model for each region was rerun with the yield tables for young croptypes set to the same volumes as the old croptypes yield tables (that is, no increased yields for young stands). Collated national results (Figure 5.2) show how the expectation of higher yields for young croptypes translates through into substantially higher future wood availability.

The impact of increased yields from the young croptypes is significant (up to 5 million cubic metres per year in the mid 2020s). By examining the large-scale owners' intentions, it is clear that these owners are anticipating the higher future yields. Figure 5.3 shows that intended harvest volume levels after 2015 can only be sustained if the young croptypes have higher yields compared to old croptypes. A key assumption in the forecasts is that these higher yields also apply to the small-scale owners' forests planted after 1989.

FIGURE 5.1: AVERAGE RADIATA PINE CLEARFELL RECOVERED VOLUME PER HECTARE UNDER SCENARIO 4 – ALL OWNERS

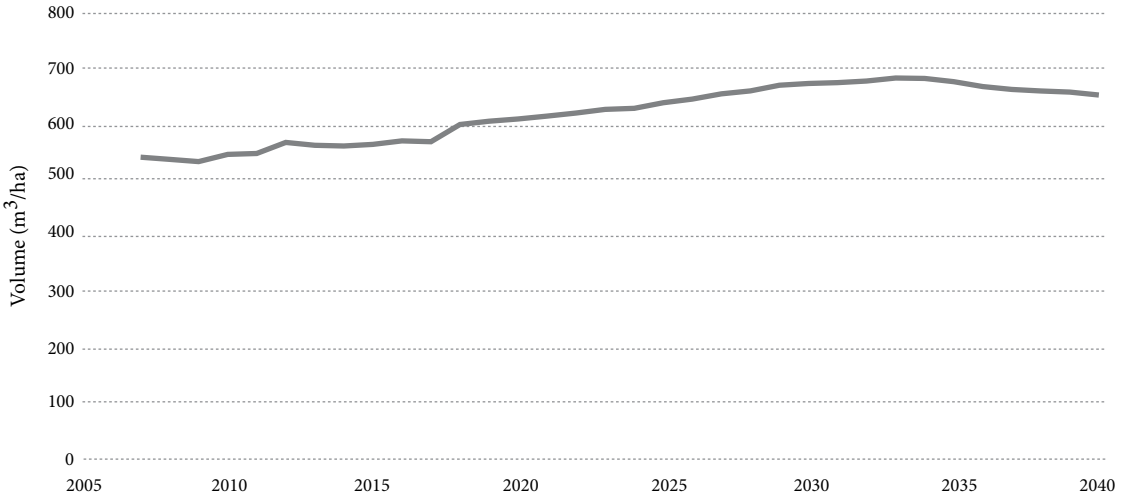


FIGURE 5.2: SENSITIVITY TO ASSUMED INCREASED GROWTH FROM YOUNG STANDS, SCENARIO 4 – CLEARFELLING VOLUMES

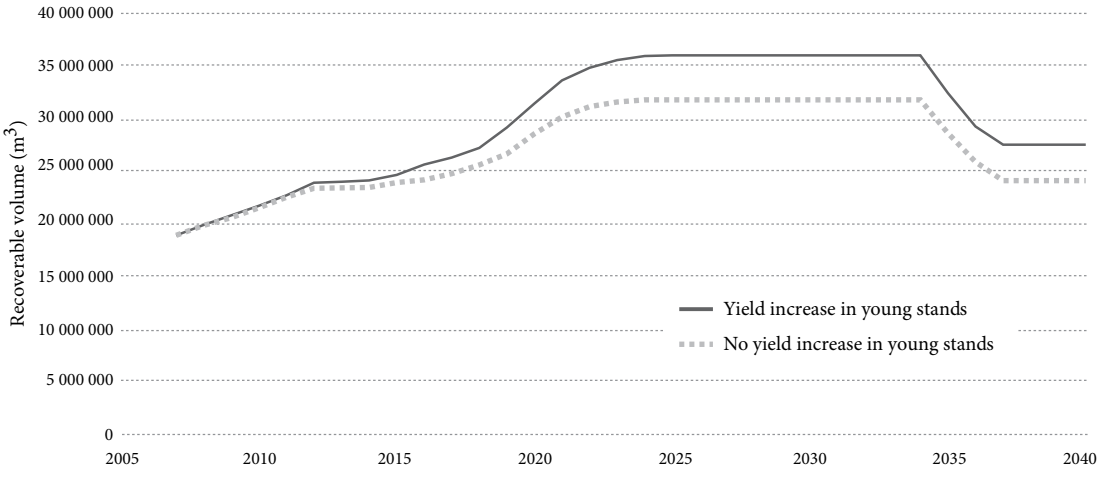
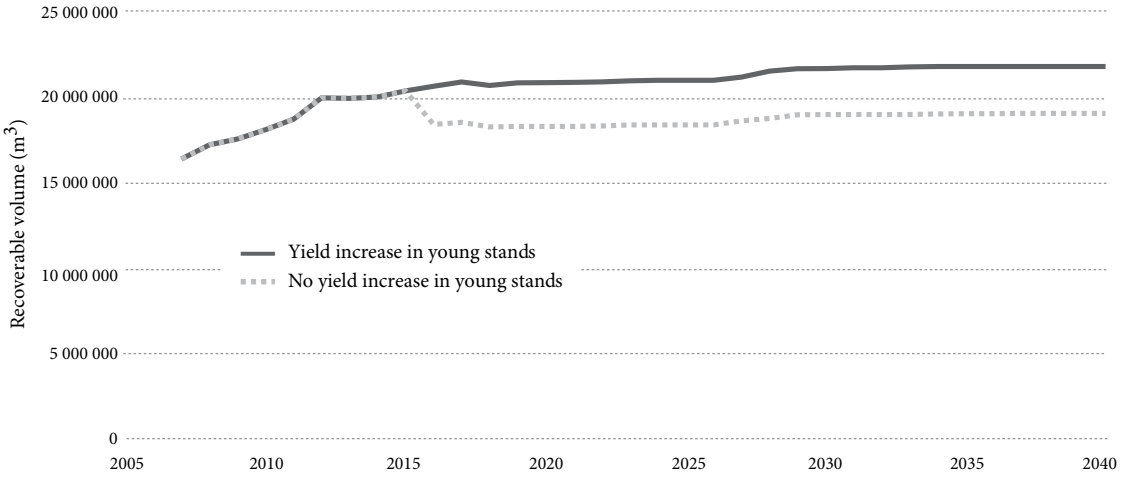


FIGURE 5.3: NEW ZEALAND RADIATA PINE AVAILABILITY FOR LARGE-SCALE OWNERS (SCENARIO 4) SHOWING THE IMPACT OF DIFFERENT GROWTH RATE ASSUMPTIONS – CLEARFELL VOLUMES



DEFORESTATION

The regional wood availability forecasts assumed relatively little deforestation from 2008 onwards. To examine the impacts of deforestation on future wood availability, further analysis was undertaken. This was done using results from the *2008 Deforestation Intentions Survey* (Manley, 2009), in which large-scale owners were asked for their deforestation intentions through to 2020 under three different situations:

- with an Emissions Trading Scheme (ETS) – where owners of pre-1990 forest are required to surrender deforestation emission units to cover greenhouse gas emissions from deforestation;
- with offset planting (Amended ETS) – this assumes that future amendments are made to the ETS to allow offset planting; that is, landowners would be permitted to deforest without cost provided that they afforest the same area elsewhere in New Zealand;
- no ETS – this assumes that the ETS is repealed and not replaced by any other legislation that limits land use change.

In the *Deforestation Intentions Survey,* an allowance was also made for deforestation by small-scale owners. The assumptions were:

- with an ETS – 90 percent of area harvested by small-scale owners will be replanted after harvesting (10 percent deforestation);
- with offset planting – 85 percent of area will be replanted after harvesting (15 percent deforestation);
- no ETS – 80 percent of area will be replanted (20 percent deforestation).

The modelled impact of future wood availability from these three deforestation scenarios is compared with the scenario 4 forecast presented earlier in this report (Figure 4.9).

Note the graphs in this section have been extended to 2060 to show impacts of deforestation in the next rotation.

Figure 5.4 shows the impact of deforestation by large-scale owners: this could reduce wood availability by up to 800 000 cubic metres per year in perpetuity. This assumes that no additional afforestation occurs. The largest decrease would be in the Central North Island.

The impact of small-scale owners (post-1989 forests) not replanting after harvesting is shown in Figure 5.5. The different levels of deforestation by the small-scale owners do not have an impact until the second rotation is harvested leading into the 2050s.

The combined (large-scale and small-scale) impact of different levels of deforestation is shown in Figure 5.6.

The overall impact of the levels of deforestation likely to

FIGURE 5.4: SENSITIVITY TO DIFFERENT LEVELS OF DEFORESTATION (NEW ZEALAND RADIATA PINE *LARGE-SCALE* OWNERS ONLY, SCENARIO 4)

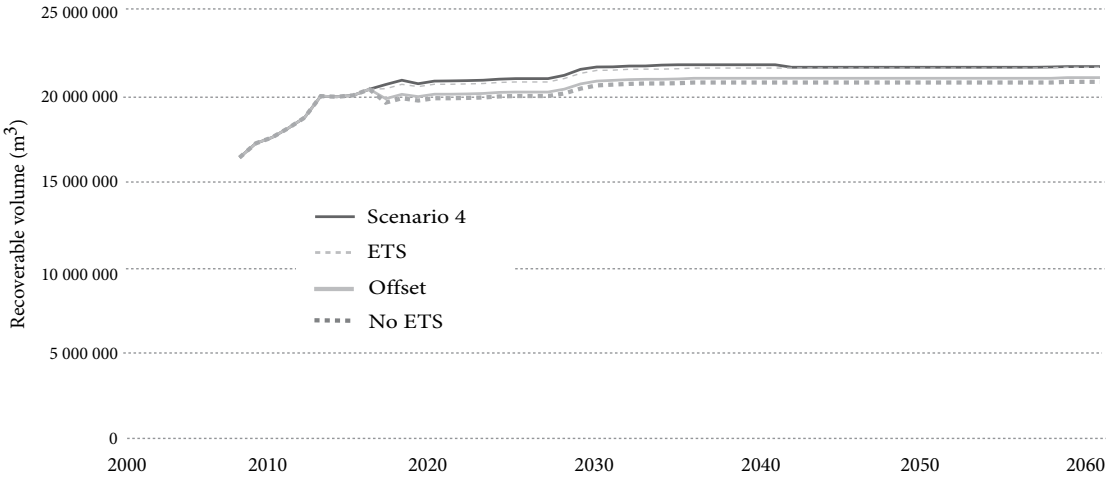


FIGURE 5.5: SENSITIVITY TO DIFFERENT LEVELS OF DEFORESTATION (NEW ZEALAND RADIATA PINE *SMALL-SCALE* OWNERS ONLY, SCENARIO 4)

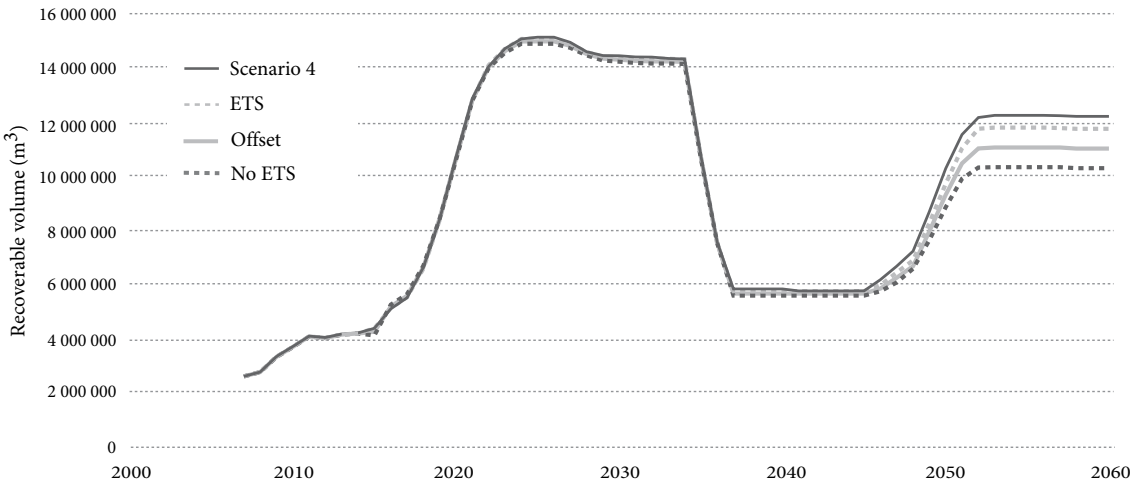
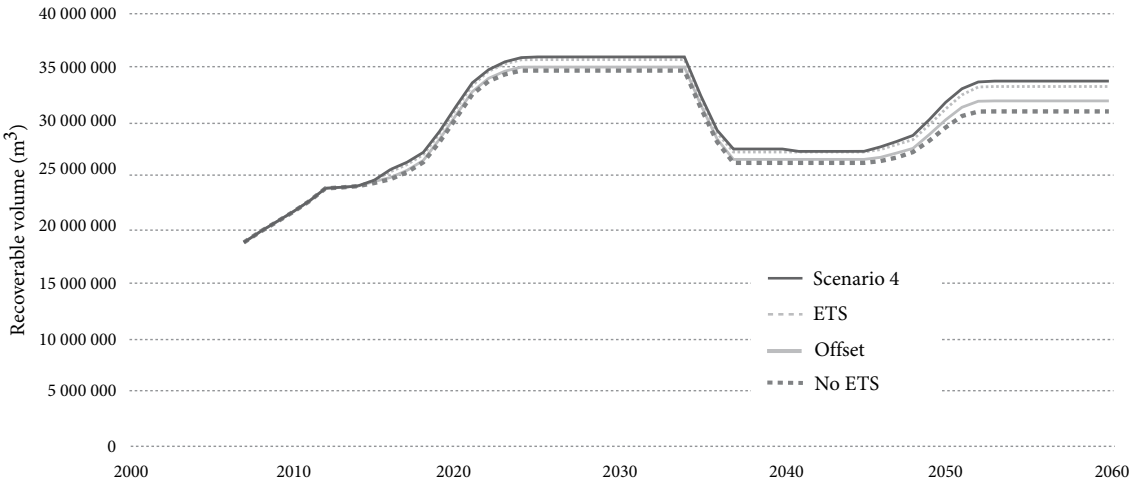


FIGURE 5.6: SENSITIVITY TO DIFFERENT LEVELS OF DEFORESTATION (NEW ZEALAND RADIATA PINE *ALL* OWNERS, SCENARIO 4)



be seen over the next 5 to 10 years is a relatively modest decline in wood availability.

LONG-TERM REDUCTION IN WOOD AVAILABILITY IN THE 2030s

Based on the large areas of afforestation during the mid-1990s, wood availability increases significantly during the 2020s. After this area has been harvested, wood availability is likely to decline. The timing and extent of any decline in wood availability beyond 2030 will depend on harvesting levels up to that point, on economic drivers, costs and the extent of any new planting or deforestation.

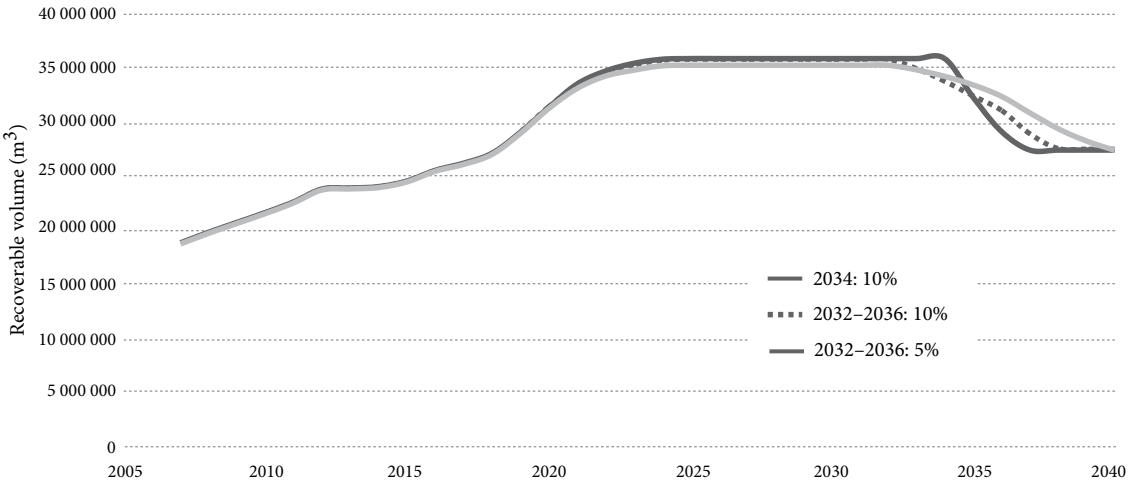
Scenarios 1 and 2 assume forest area is available at a fixed rotation age. In this situation wood availability simply mirrors the age structure of New Zealand's forests – rising sharply during the early 2020s as the forests planted in the mid-1990s mature. Then after a peak in 2024, wood availability declines just as rapidly out to 2035. For logistical reasons, future harvesting will not track wood availability. In all likelihood the harvesting of forests established during the 1990s will be spread out over a longer period of time than the forests were established; therefore rotation lengths will be extended. This is the approach taken in scenario 4 where all regional models had non-declining yields until 2034 – then an annual reduction of 10 percent per year was allowed for 3 years. This approach has created a sheer drop-off that is an artefact of the model assumptions – although useful to highlight the likelihood of a declining harvest sometime in the future, it is not likely that the decline will follow the same pattern in each region.

To show alternative declines in wood availability, the regional models were rerun in which:

- the drop-off varies by region depending on how "spiked" the small-scale estate age-class is for the 1990 to 2005 plantings;
- in addition, a 5 percent per year reduction was allowed for 6 years.

The effects of alternative assumptions are shown in Figure 5.7.

FIGURE 5.7: NEW ZEALAND RADIATA PINE AVAILABILITY FOR ALL OWNERS WITH VARIATIONS OF SCENARIO 4: (I) A 10% PER YEAR REDUCTION ALLOWED FROM 2034 ON (AS IN FIGURE 4.9); (II) A 10% REDUCTION ALLOWED FROM 2032 TO 2036 ONWARDS (DEPENDING ON REGION); AND (III) A 5% REDUCTION ALLOWED FROM 2032 TO 2036 ONWARDS (DEPENDING ON REGION)



Kajavala Forestry log yard at Kawerau. Photo: John Stulen/FICA.

CONCLUDING COMMENTS 6

Between 1990 and 2009, the volume of logs harvested from New Zealand's planted forests has risen from 11 million cubic metres to around 18 million cubic metres (radiata pine). The overall trend has been one of increasing harvest volumes; but fluctuations have occurred in response to market conditions such as log and lumber prices, shipping costs and movements in exchange rates. These economic factors drive the economics of forest harvesting and such factors are not able to be predicted with sufficient certainty to provide robust long-term forecasts. Instead these wood availability forecasts have been based on the quantifiable physical characteristics of New Zealand's planted production forests such as forest areas by age-class, silviculture and the recoverable log volumes per hectare. The near-term (out to 2015) harvesting intentions of the large-scale forest owners have also been embedded in the forecasts.

Most of the increase in wood availability will need to be exported as New Zealand's domestic demand for forest products is expected to grow slowly relative to future wood availability. New Zealand is a small player in international forest products trade, accounting for about 1.0 percent of the world's trade by volume. In comparison, Chile accounts for 1.4 percent of trade, Russian Federation 4.1 percent, Sweden 7.1 percent and Canada 15.9 percent.

In 2006, global consumption[10] of softwood logs was estimated to be 1 022 million cubic metres; softwood consumption by countries in the Pacific rim was estimated at 578 million cubic metres. So New Zealand's increase in wood availability of around 6 million cubic metres by 2012, and the larger increases leading into the 2020s, are small relative to the overall size of international softwood markets. However, in New Zealand's main markets of Asia, MAF estimates that New Zealand's share of softwood forest products trade by value are much more significant, at almost 20 percent (MAF, 2009b). Also, radiata pine occupies specific market segments within the softwood markets and it can not necessarily substitute other softwood species.

The increase in wood availability offers good potential for the forest industry to expand New Zealand's forest products exports. Radiata pine is a versatile softwood which can be used in a wide range of products. New Zealand also has high standards of sustainable forest management compared to many counties in the Asia-Pacific Region and more than 50 percent of the forest resource is certified under the Forestry Stewardship Certification scheme.

The References section provides web links to each of the regional wood availability forecast reports. These reports provide detailed forecasts for each region along with descriptions of each region's forests, wood processing plants and infrastructure.

10 James Turner, Scion (personal communication). This estimate is based on data from the UN Food and Agricultural Organization (FAOSTAT; FAO, 2009) and the International Tropical Timber Organisation Annual Review (ITTO, 2009).

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APPENDIX 8

TABLE A1: NEW ZEALAND HARVEST INTENTIONS SURVEY RESULTS, LARGE-SCALE OWNERS (EXCLUDES PRODUCTION THINNED VOLUME)

	2007	2008	2009	2010	2011	2012	2013	2014	2015
RADIATA PINE									
Pruned (m^3)	2 129 500	2 293 500	2 411 000	2 492 500	2 553 400	2 706 400	2 702 400	2 691 000	2 655 946
Unpruned (m^3)	10 769 755	11 327 261	11 474 626	11 841 255	12 265 489	13 050 824	13 008 891	13 104 064	13 375 175
Pulp (m^3)	3 445 694	3 551 639	3 625 874	3 720 645	3 844 611	4 154 076	4 168 009	4 164 236	4 284 179
Total (m^3)	**16 344 949**	**17 172 400**	**17 511 500**	**18 054 400**	**18 663 500**	**19 911 300**	**19 879 300**	**19 959 300**	**20 315 300**
DOUGLAS-FIR									
Unpruned (m^3)	520 970	497 714	452 186	408 216	399 974	395 256	382 112	378 886	351 869
Pulp (m^3)	130 968	119 212	108 282	98 195	93 582	92 283	90 438	89 541	86 538
Total (m^3)	**651 938**	**616 925**	**560 468**	**506 410**	**493 555**	**487 539**	**472 550**	**468 427**	**438 407**

TABLE A2: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 1 (UNCONSTRAINED CUT), ALL OWNERS

Scenario 1 assumes that all owners cut trees at a fixed rotation length.

YEAR ENDING DECEMBER	RECOVERABLE VOLUME (000 M^3 IB)
2007	17 794
2008	21 195
2009	22 079
2010	21 064
2011	24 246
2012	28 234
2013	29 214
2014	28 102
2015	26 528
2016	28 361
2017	23 513
2018	20 357
2019	23 527
2020	20 965
2021	21 148
2022	40 050
2023	44 911
2024	63 532
2025	52 120
2026	52 119
2027	40 931
2028	35 793
2029	32 507
2030	32 874
2031	32 425
2032	30 773
2033	28 852
2034	24 134
2035	15 882
2036	16 015
2037	25 273
2038	22 770
2039	26 186
2040	25 906

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

TABLE A3: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 2

Scenario 2 assumes that large-scale owners cut at stated intentions, and small-scale owners cut at age 30.

	RECOVERABLE VOLUME		
YEAR ENDING DECEMBER	LARGE-SCALE OWNERS (000 M^3 IB)	SMALL-SCALE OWNERS (000 M^3 IB)	ALL OWNERS (000 M^3 IB)
2007	16 345	2 682	19 027
2008	17 172	3 254	20 426
2009	17 512	4 201	21 713
2010	18 054	3 165	21 220
2011	18 663	2 920	21 584
2012	19 911	3 207	23 119
2013	19 879	3 172	23 051
2014	19 959	4 110	24 070
2015	20 315	4 342	24 657
2016	20 521	4 612	25 133
2017	20 617	3 205	23 822
2018	20 453	2 318	22 771
2019	20 615	4 936	25 551
2020	20 625	6 024	26 649
2021	20 736	4 845	25 581
2022	20 900	21 922	42 822
2023	20 964	27 849	48 813
2024	20 980	39 683	60 663
2025	20 980	26 855	47 835
2026	20 980	28 242	49 222
2027	21 274	21 290	42 564
2028	21 426	13 596	35 022
2029	21 666	11 872	33 538
2030	21 685	11 197	32 882
2031	21 685	11 953	33 638
2032	21 685	8 556	30 241
2033	21 685	6 687	28 372
2034	21 694	4 544	26 238
2035	21 694	2 397	24 091
2036	21 738	1 522	23 261
2037	21 738	2 431	24 169
2038	21 738	2 631	24 370
2039	21 738	3 171	24 910
2040	21 738	4 316	26 054

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

TABLE A4: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 3

Scenario 3 assumes a non-declining yield with a target rotation of 30 years.

	RECOVERABLE VOLUME		
YEAR ENDING DECEMBER	LARGE-SCALE OWNERS (000 M^3 IB)	SMALL-SCALE OWNERS (000 M^3 IB)	ALL OWNERS (000 M^3 IB)
2007	16 345	2 642	18 987
2008	17 172	2 802	19 975
2009	17 512	3 435	20 946
2010	18 054	3 831	21 885
2011	18 663	4 222	22 886
2012	19 911	4 197	24 108
2013	19 879	4 356	24 235
2014	19 959	4 454	24 413
2015	20 315	4 632	24 947
2016	20 509	5 578	26 086
2017	20 622	6 267	26 889
2018	20 376	7 370	27 746
2019	20 464	8 283	28 747
2020	20 498	10 408	30 906
2021	20 530	10 789	31 319
2022	20 652	10 978	31 631
2023	20 774	11 061	31 835
2024	20 790	11 050	31 840
2025	20 790	11 050	31 840
2026	20 790	11 050	31 840
2027	20 954	10 886	31 840
2028	21 089	10 750	31 840
2029	21 286	10 554	31 840
2030	21 402	10 437	31 840
2031	21 443	10 396	31 840
2032	21 447	10 393	31 840
2033	21 447	10 393	31 840
2034	21 447	10 393	31 840
2035	21 541	10 299	31 840
2036	21 541	10 299	31 840
2037	21 568	10 272	31 840
2038	21 649	10 191	31 840
2039	21 690	10 149	31 840
2040	21 722	10 118	31 840

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

TABLE A5: NEW ZEALAND RADIATA PINE AVAILABILITY UNDER SCENARIO 4, BY LOG GRADE, FOR ALL OWNERS

Scenario 4 assumes a split non-declining yield with a target rotation of 30 years.

		RECOVERABLE VOLUME BY LOG GRADE		
YEAR ENDING DECEMBER	TOTAL (000 M^3 IB)	PRUNED LOGS (000 M^3 IB)	UNPRUNED LOGS (000 M^3 IB)	CHIP LOGS (000 M^3 IB)
2007	18 984	2 460	12 550	3 974
2008	19 979	2 634	13 246	4 099
2009	20 891	2 904	13 731	4 256
2010	21 794	3 053	14 336	4 404
2011	22 778	3 238	14 918	4 622
2012	23 987	3 199	15 794	4 994
2013	24 074	3 368	15 751	4 955
2014	24 195	3 380	15 851	4 964
2015	24 721	3 425	16 221	5 075
2016	25 715	3 399	17 010	5 306
2017	26 371	3 596	17 372	5 404
2018	27 295	3 665	17 882	5 748
2019	29 238	3 894	19 211	6 133
2020	31 527	4 076	20 784	6 666
2021	33 716	4 421	22 156	7 140
2022	34 919	4 567	22 972	7 381
2023	35 654	4 775	23 402	7 477
2024	36 040	4 941	23 593	7 506
2025	36 094	5 031	23 643	7 420
2026	36 093	5 016	23 657	7 420
2027	36 093	4 798	23 844	7 451
2028	36 100	4 809	23 852	7 439
2029	36 097	4 678	23 936	7 483
2030	36 090	4 667	23 983	7 440
2031	36 091	4 684	23 993	7 414
2032	36 090	4 607	24 040	7 443
2033	36 087	4 436	24 137	7 515
2034	36 088	4 107	24 324	7 657
2035	32 506	3 740	21 879	6 887
2036	29 333	3 452	19 684	6 197
2037	27 601	3 242	18 486	5 873
2038	27 602	3 163	18 532	5 908
2039	27 602	3 091	18 572	5 939
2040	27 600	3 020	18 608	5 973

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

TABLE A6: NEW ZEALAND RADIATA PINE RECOVERABLE VOLUME AND AVERAGE CLEARFELL AGE FOR EACH TARGET ROTATION AGE UNDER SCENARIO 5, FOR ALL OWNERS

Scenario 5 assumes a split non-declining yield with target rotations of 28, 30 and 32 years.

	28-YEAR ROTATION		30-YEAR ROTATION		32-YEAR ROTATION	
YEAR ENDING DECEMBER	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)
2007	19 092	30	18 984	30	18 805	29
2008	20 745	30	19 979	30	18 917	30
2009	21 929	30	20 891	29	19 273	29
2010	22 767	30	21 794	29	19 942	30
2011	23 901	29	22 778	30	20 988	30
2012	25 071	29	23 987	30	22 174	30
2013	25 360	30	24 074	30	22 417	30
2014	25 821	30	24 195	30	22 365	30
2015	26 535	29	24 721	30	22 677	31
2016	28 477	29	25 715	30	22 901	31
2017	30 620	29	26 371	30	23 238	31
2018	33 132	29	27 295	30	23 609	31
2019	34 210	29	29 238	30	24 022	31
2020	34 565	29	31 527	30	25 774	31
2021	34 736	29	33 716	30	28 068	31
2022	34 736	29	34 919	30	30 451	31
2023	34 766	29	35 654	30	32 563	31
2024	34 766	29	36 040	30	34 164	31
2025	34 766	30	36 094	30	35 887	32
2026	34 766	30	36 093	31	37 086	32
2027	34 766	30	36 093	31	37 381	32
2028	34 766	30	36 100	31	37 474	32
2029	34 766	31	36 097	32	37 576	33
2030	34 766	31	36 090	32	37 581	33
2031	34 766	31	36 091	32	37 581	33
2032	34 766	30	36 090	32	37 581	34
2033	31 311	30	36 087	32	37 581	34
2034	28 719	30	36 088	32	37 581	34
2035	27 276	30	32 506	32	37 581	34
2036	27 276	29	29 333	31	37 581	34
2037	27 276	29	27 601	31	33 845	34
2038	27 276	28	27 602	31	30 482	34
2039	27 276	28	27 602	31	28 107	33
2040	27 294	28	27 600	30	28 107	33

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

TABLE A7: NEW ZEALAND DOUGLAS-FIR RECOVERABLE VOLUMES AND AVERAGE CLEARFELL AGE

	LARGE-SCALE OWNERS		SMALL-SCALE OWNERS			
YEAR ENDING DECEMBER	RECOVERABLE VOLUME (000 M^3 IB)	AVERAGE AGE (YEARS)	RECOVERABLE VOLUME (000 M^3 IB)	AVERAGE AGE (YEARS)	PRODUCTION THIN VOLUME (000 M^3 IB)	TOTAL VOLUME (000 M^3 IB)
2007	652	44	42	49	4	698
2008	617	44	67	49	4	688
2009	560	43	52	46	4	617
2010	506	43	51	44	6	564
2011	494	43	46	44	6	545
2012	488	43	54	44	5	547
2013	473	43	48	44	5	526
2014	468	43	47	43	16	531
2015	438	43	52	44	15	505
2016	662	44	54	42	20	735
2017	661	45	41	44	20	721
2018	661	44	58	44	20	739
2019	708	44	51	44	9	768
2020	669	44	73	44	9	751
2021	632	44	54	45	5	691
2022	643	44	44	45	8	695
2023	649	44	76	44	31	756
2024	756	44	62	45	51	869
2025	816	45	87	43	109	1 012
2026	793	44	73	44	191	1 057
2027	793	45	83	44	373	1 249
2028	815	45	84	43	516	1 415
2029	766	45	94	43	572	1 431
2030	762	45	158	42	527	1 447
2031	762	45	174	42	491	1 428
2032	762	45	226	41	329	1 316
2033	840	44	273	41	173	1 286
2034	1 002	42	301	41	116	1 419
2035	1 175	42	301	41	101	1 577
2036	1 344	42	367	41	60	1 771
2037	1 524	42	494	42	40	2 059
2038	1 649	42	645	42	31	2 325
2039	1 668	42	855	42	12	2 535
2040	1 668	42	865	42	13	2 546

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