

MANGAMINGI FOREST

Owned by
LANDCORP FARMING LTD

Forest Management Plan

For the period 2014 / 2019



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1. INTRODUCTION

Principles and Criteria

Landcorp Farming Ltd is committed to adopt the Forest Stewardship Council (FSC) Principles and to meet their Criteria and the FSC standards of good forest management. These standards include ecological, social and economic parameters.

Landcorp Farming Ltd is committed to the PF Olsen FSC Group Scheme that is implemented through the Group Scheme Member Manual and associated documents.

About this Plan

This document provides a summary of the forest management plan and contains:

- Management objectives;
 - A description of the land and forest resources;
 - Environmental safeguards;
 - Identification and protection of rare, threatened and endangered species;
 - Rationale for species selection, management regime and harvest plan and techniques to be used;
 - Appropriate management of unstocked reserve areas;
 - Maps showing plantation area, legal boundaries and protected areas;
 - Provisions for monitoring and protection.
-

2. Forest Investment Objectives

Provision of services

Landcorp Farming Ltd’s objective is to obtain an economic return on investment while providing environmental benefits, including:

- Enhanced water quality;
 - Soil, stabilisation and conservation;
 - Providing a buffer against flooding during storms;
 - Shading waterways for aquatic life;
 - Enhance wildlife and plant habitat leading to increased biodiversity;
 - A reduction in greenhouse gases;
 - Economic and social benefits to the community and Landcorp Farming Ltd.
-

Forest management goals

The forest is managed to:

- Grow trees and produce logs for the manufacturing of different wood products in New Zealand and overseas with a focus on describe primary products;
- Ensure that the productivity of the land does not decline;
- Ensure that environmental values are identified and maintained;
- Ensure that historic sites are identified and protected;
- Ensure that other forest values and products are identified, protected and where possible enhanced;
- Harvest the trees as close as possible to their economic optimum age;
- Replant following harvesting; and
- Enter any other objectives specific to the forest area.

These objectives are delivered via the Quality Management System implemented by PF Olsen that includes ISO 9001 and ISO 14001 certification, and FSC environmental certification (when requested by the customer).

All activities within Mangamingi Forest are subject to management within a framework set by PF Olsen’s environmental policies and Environmental Management System (EMS).

Environmental policy

PF Olsen Limited Environmental Policy:

PF Olsen Ltd is committed to:

- *Sustainable forest and land management;*
- *Promoting high environmental performance standards that recognise the input from the community in which we operate;*
- *Where appropriate applying the Principles and Criteria of the Forest Stewardship Council across forest management.*

Substantial additional detailed policies are contained within PF Olsen’s Environmental Management System (EMS).

EMS framework

The EMS is a core document defining the policies, processes and procedures that govern the physical implementation of forest management activities. The EMS applies a systematic approach certified to ISO 14001 standards to ensure that prevention of adverse and harmful impacts is effective.

An Environmental Management Group (EMG) assists the Environmental Manager, who is responsible for ensuring that the EMS is maintained and implemented. Internal audits to ensure compliance with the EMS and to improve the procedures of the EMS are undertaken at least once every two years.

3. Forest Landscape Description

Overview

This section describes the physical and legal attributes of the land on which the forest is located. Included in this section are discussions of:

- Location and access;
 - Topography;
 - Soils;
 - Climate;
 - Legal ownership and tenure.
-

Location and access

Mangamingi forest is located off Mangamingi Road, which in turn is located off Tutukau Road, off state highway 5 north of Taupo. The station office is 6.8km up Mangamingi Road. Internal farm tracks provide access to all parts of the forest.

The location of the forest in relation to potential markets is listed in the table below and shown in Map 1.

Table 1: Distances from forest to log markets

Potential Market or Export Port	Distance from Forest (km)	Log market
Tauranga	112	Export
Taupo	39	Domestic
Kinleith	82	Pulp

Topography

The topography of the forestland is predominantly rolling to steep contour.

Whilst this is not all difficult harvesting terrain, parts are very uneven due to volcanic protrusions and the highly erodible pumice soils mean wet weather poses challenges for lower cost harvesting options.

Harvesting is to be targeted for the drier period of the year, specifically October to April period and much of the area requires cable harvesting systems. Remaining portions will be suitable for ground based machine extraction with and without tracking.

Altitude is 316 to 657m above sea level.

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Soils

There are two major soil types that comprise Mangamingi station. The easier country comprises Oruanui hill soils, silty sand and the steeper areas of the farm are Tauhara steepland soils. Both soil types are yellow brown pumice soils from Taupo pumice.

Erosion risk of these soils on steep slopes is high, and consequently the land of many forested areas is already subject to a soil conservation covenant.

Harvesting and roading methods will need to consider the erosion risk in operational management. In particular these soils contain unconsolidated pumice bands that once exposed are easily dislodged under rain impact or “floated” if subject to exposure to moving bodies of water. The consequence can be large runnels and channels formed in single rain storm events with substantial sediment deposition. Careful water control techniques to prevent water accumulation and lower flow velocities are critical as well as protection of surfaces from unnecessary disturbance or rectification of damage.

Climate

Rainfall: The average rainfall at nearby Atiamuri power station is about 1340mm per year and is relatively evenly distributed during the year. January to March is the driest period.

Temperature: The mean annual temperature is around 18.1 degrees Celsius. Ground frosts can occur throughout the year (except January and February) with an average of 53 ground frosts per year.

Legal ownership

The legal description of the land on which the forest is situated is:

Section 1 SO58805
Section 1 SO58775
Section 9 Block XI Ngongotaha SD

The tenure is freehold.

The ecological landscape

The area containing the Mangamingi forests is on the southern end of the Paeroa range. This range is an tilted rift ridgeline of volcanic origin running more or less NE – SW from Rotorua, the upper slopes remaining clothed in relatively lightly disturbed indigenous tall forests.

This formation ends at Mangamingi as does most of the indigenous forest with only a few remnant patches remaining within the farmland matrix. The whole Paeroa formation and forest is isolated from other large tracts of indigenous forest by farmland though close proximity to exotic forests at the Rotorua end probably assists in maintaining this area as a potentially important corridor and refugia within an otherwise heavily modified environment.

The total landscape falls within the Atiamuri Ecological District which is typified¹ by complex relief, traversed by Rotorua-Taupo Graben, groups of rhyolite domes, the tilted ignimbrite Paeroa Range (to 900m a.s.l.) with pumice tuffs, breccias, alluviums on low lands. Soils are coarse textured volcanic ash soils, Taupo tephra being very significant. There was extensive, Polynesian clearance, with remnant forests on domes and range, now widely logged. Today only approx 8.2% of the total original 220,439 ha of native vegetation cover remains.

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¹ http://www.bush.org.nz/ecologicaldistrict/16_01.html

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Protective Status

The following table shows vegetation types as required by the National Standard for Plantation Forest Management in New Zealand revised in 2013. The predominant Land Environment (LENZ code) represented by the indigenous ecosystems remaining within Mangamingi is F7.1, the statistics of which are listed below. Smaller but significant components are classed F6.2, with an estimated pre-human distribution 342,713ha, of which unusually 94.3% remains today and 70.9% is formally protected.

Table 2: Protective status of the ecological landscape

LENZ type:	LENZ F7.1
Original (pre-Maori) percentage of ecosystem type in Ecological District within land title:	494186ha 100%
Natural ecosystem area remaining	75601ha 15.3%
Proportion of remaining natural ecosystem under protection:	59807ha 79.1%
Protection by certificate holder	131ha 0.22%
Protected areas as a % of this management estate.	172.7ha 13.5%
Protected areas as a % of the aggregated Group Scheme management estate by Ecological District	196.2ha 8.9%

**Threatened
Environments
Classification**

The Landcare Threatened Environments Classification (TEC) is a measure of how much indigenous vegetation remains within land environments, its legal protection status, and how past vegetation loss and legal protection are distributed across New Zealand’s landscape. The TEC is a combination of three national databases:

- Land Environments New Zealand (LENZ)
- Landcover Database 2
- Protected Areas Network

The TEC uses indigenous vegetation cover as a surrogate for indigenous biodiversity, which includes indigenous ecosystems, habitats, and communities; the indigenous species, subspecies and varieties that are supported by indigenous vegetation; and their genetic diversity. It uses legal protection as a surrogate for the relative vulnerability of indigenous biodiversity to pressures such as land clearance, extractive land uses, and the effects of fragmentation. The TEC is therefore most appropriately applied to help identify places that are priorities for formal protection against clearance and/or incompatible land uses, and for ecological restoration to restore lost species, linkages and buffers.

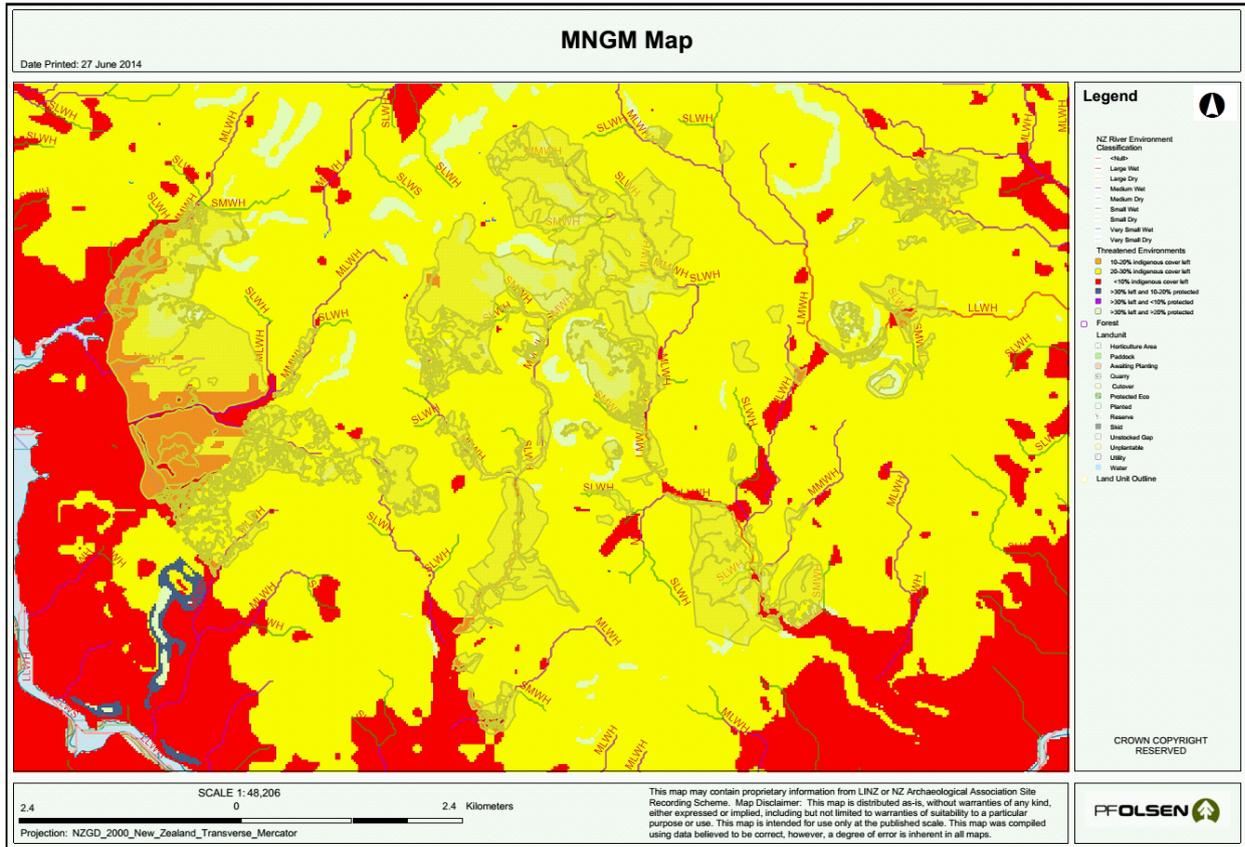
The table on the following page shows the threatened environments classifications as they pertain to this forest.

Table 3: Reserve areas by Threatened Environments Classification

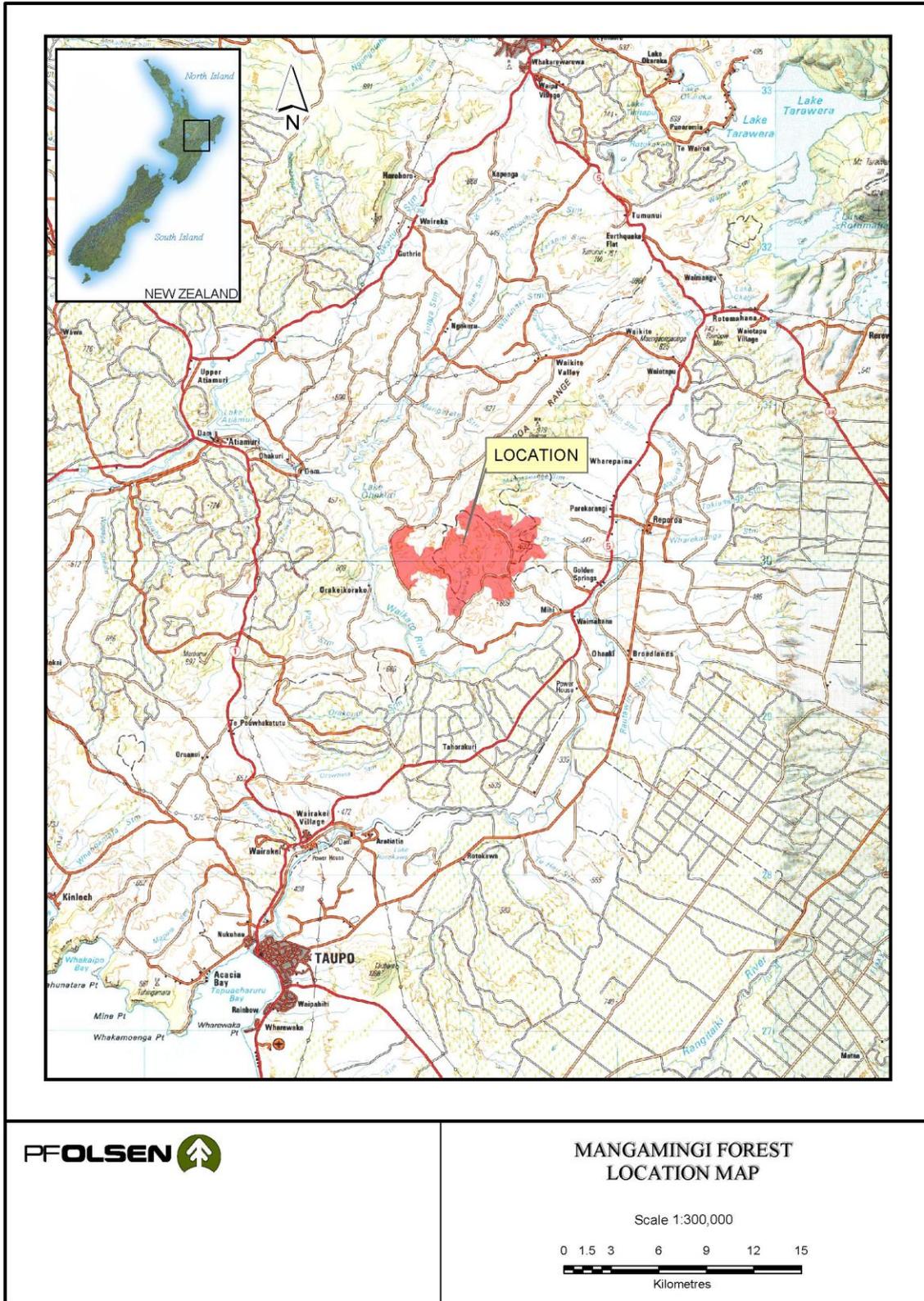
	Mangamingi
<10% indigenous cover left	30.7ha 17.7%
10-20% left	
20-30% left	142ha 82.3%
>30% left and <10% protected	
>30% left and 10-20% protected	
>30% left and >20% protected	
TOTAL	172.7ha 100%

The TEC status of the small reserves reflects the history of intensive pastoralism in the area. The reserves thus have value due to their paucity in the overall landscape.

Forest by Threatened Environments Classification



4. Map 1 - Forest Location Map



5. Socio-economic profile and adjacent land

Forest history

Mangamingi station is a sheep and beef pastoral farming operation.

Forestry has been established on the station primarily for the purpose of soil conservation, but also as shelter for stock and alternative species for farm aesthetics.

Areas established in forestry were predominantly low productivity sites in agricultural terms, due to the instability of the slopes.

Current social profile

The forests on Mangamingi station are an, intermittent, incremental contributor to the social profile of the area. The forests are very small in comparison to large forestry players in the region. The land and forests are privately owned and contribution to the local economy by way of added incremental employment and infrastructure is relatively low although there has been a near continuous period of harvest in recent years.

The Waikato region, in which Mangamingi Forest falls, is one of the most populated in New Zealand (from Statistics NZ):

- 382,716 people
- 4th largest population out of the 16 regions in NZ
- 9.5% of New Zealand's population
- Maori population size ranks 2nd out of the 16 regions in NZ

Combining data from the Atlas of Deprivation (Ministry of Health) and average income from Statistics NZ, it is apparent that wealth varies widely across the region. The area of the region where Mangamingi Forest is located appears to be one of the lesser deprived areas in the region. Age and family statistics for the Waikato region are very similar to national averages.

Associations with Tangata Whenua

The land at Mangamingi is freehold. However, iwi associated with the region where Mangamingi is located is Ngati Tahu and Ngati Whaoa. No specific concerns in respect of this land title are currently known.

Tenure & resource rights

A search of the Maori Land Online website returned no results.

Neighbours

Neighbours to the forest estate boundaries have a special interest in the management of the forest. Activities within the forest may positively or negatively impact upon their quality of life or businesses in a number of ways, while inappropriately managed operations could create risks of adverse health, safety and environmental hazards. Neighbours may use the forests for recreational purposes or place reliance on the forests for provision of water quality or quantity services. Boundary issues such as weed and pest control, access and boundary alignment issues may also involve neighbours.

The following table lists the forest neighbours and their primary activities. Some or all of these parties should be consulted when operations are proposed in forest areas adjacent to their boundaries. A location map is included in Appendix 1.

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Table 4: Forest neighbours

Owner/Occupier	Contact #	Location (See Location Map)	Activities	Other Notes
Department of Conservation - Rotorua				Paeroa Ranges
BIGNELL, Steven James & THOMAS, Kelvin Keith			Sheep and beef farm.	
SPARGO, Chris & WILSON, Douglas & Susan			Sheep and beef farm.	
Kusabs, Ngamotu, Sullivan and more				
HUGHES, Ruth M & Stephen R			Eucalypts	
HUGHSON, June M & Peter H			Sheep and beef farm.	
HALL, Colleen NL & James P			Sheep and beef farm.	
BRODERSON, Robert				
CHADWICK, Maureen D & Vernon			Sheep and beef farm.	
SCHUMACHER, Gregory E & Margaret C			Dairy farm.	
MCFADDEN, Gifford P & Robin			Dairy farm.	
COATES, William RB Ngahiwi Farms Ltd			Sheep, beef and deer farm.	
RUSSELL, David B			Sheep and beef farm.	
Armstrong Property Holdings Ltd			Radiata plantation.	
SALT, Alec			Dairy farm.	
Te Kopia Forest No.1 Ltd			Radiata plantation.	
BLACKMAN, Ian & FEAR, Athene & Ian			Sheep and beef farm.	
ROTHMAN, John & Pauline				

6. The Regulatory Environment

Regulatory considerations

In order to minimise the risk to forest owners, managers and contractors, it is important that relevant legislation and agreements are identified and appropriate measures put in place to ensure that breaches of legislation are avoided.

The following legislation and agreements summarise key regulatory and voluntary controls that currently apply to forest operations in the forest.

Resource Management Act

Mangamingi Forest is subject to the provisions of the Resource Management Act (RMA) 1991. The RMA sets up a resource management system that promotes the sustainable management of natural and physical resources and is now the principal statute for the management of land, water, soil and other resources in New Zealand.

Under the RMA, Mangamingi Forest falls under the Rotorua District Council for land management issues and the Waikato Regional Council for soil conservation and water quality issues.

District Plan

Mangamingi Forest falls under the jurisdiction of the Rotorua District Council. The current plan is the proposed district plan and was notified in 2012.

Under the plan this block is zoned Rural 1 – Working Rural.

Table 5: District Plan rules as they affect forestry

Rule Ref	Status	Requirement
9.5.9	Permitted	Plantation forestry including harvesting
9.5.33	Discretionary	Mining and Quarrying
9.6.6	Permitted	Noise levels shall comply with maximum noise levels. Daytime – 7am to 10pm – 50L _{Aeq} Night-time and at all other times – 40L _{Aeq} and 75L _{Amax}
9.5.53	Discretionary	HNZ authority required for disturbance of an archaeological site or historic site, waahi tapu and other taonga.

Regional Plan The forest comes under the jurisdiction of Waikato Regional Council as the Regional Council.

The Waikato Regional Plan is operative in full.

Rules as they currently affect Mangamingi Forest are:

Table 6: Regional Plan rules as they affect forestry

Rule Ref	Status	Requirements
3.9.4.11	Fertiliser use	Permitted.
4.2.8	Bridges	Permitted- 10m in length and associated bed disturbance and sediment discharge, subject to conditions.
4.2.9	Culverts	Permitted- culverts in the bed of a river for catchments not exceeding five hectares upstream of the culvert, and subject to conditions.
4.2.11	Fords	Permitted, subject to conditions in rule.
4.2.21	Water discharge standards	Suspended Solids Discharge Standards for Permitted Activity Rules in Chapters 4.2.
5.1.4.11	Replanting	Permitted- setback 5m from ephemeral stream. Spot cultivation can not occur within 2m of a stream bed.
5.1.4.11, 5.1.4.13 5.1.4.14, 5.1.4.15	Roading and tracking	Permitted- soil disturbance, roading and tracking, where area is not a high risk erosion area. See rule for definition of high risk. Works in a high risk erosion area are controlled, within stated limits and discretionary outside stated limits.
5.1.4.11, 5.1.4.13, 5.1.4.14, 5.1.4.15	Vegetation clearance	Permitted- Vegetation clearance of planted production forest. Controlled- clearance in riparian zones (excludes production forestry). Rule does not apply to vegetation clearance within high risk erosion areas that is being completed for erosion control.
5.2.5.4	Cleanfill	Permitted- small scale cleanfill disposal outside of high risk locations (see rule for definition of high risk areas). Not exceeding 2,500 cubic metres per annum. Note: rule does not for roading and tracking which are addressed by methods and rules in Section 5.1.4.
6.2.4.8, 6.2.4.9,	Agrichemical Application	Permitted- spot spraying using handheld equipment Permitted- widespread application of agrichemicals. Ground based application, 12 hours notification to parties within 50m of boundary. Aircraft application, spray plan notified 12 hours to three weeks to people likely to be affected.

**Historic and
archaeological
sites**

Under the Historic Places Act 1993 it is the landowner's responsibility to identify any historic sites on their land prior to undertaking any work which may disturb or destroy such sites. Records of archaeological and historical places are maintained in the NZ Archaeological Association (NZAA) Site Recording Scheme <http://www.archsite.org.nz/>.

If a site is found or suspected on any block, the protocols specified in PF Olsen's EMS, and any others specifically developed in conjunction with HPT and Iwi or other stakeholders, must be observed. Where such circumstances require, an 'Authority to Modify or Destroy' will be sought from HPT. Such authorities are similar in function to a resource consent and, if granted, normally come with conditions that must be met. The process to apply for authorities is documented in PF Olsen's EMS.

Note also that authorities to modify an archaeological site may sometimes be required from the local District Council and sites of cultural significance are often included in schedules of places and sites of significance in District Plans. Update checks for any sites will be required before any harvesting or related earthworks commences.

Checks of the NZAA website show no known records within any considerable distance of this block. Similarly a check of the Archaeological Site Probability model published by the Department of Conservation² suggests that this very inland location, not adjacent to any lakes is unlikely to have sites present.

² Arnold, G.; Newsome, P.; Heke, H. 2004: Predicting archaeological sites in New Zealand. *DOC Science Internal Series 180*. Department of Conservation, Wellington. 24 p.

Consents & authorities held

A resource consent from Waikato Regional Council is currently held for harvesting and earthworks in Mangamingi Forest. Conditions include providing the council with an annual sediment and erosion control plan, inspecting works within 65 hours of a major storm event, full engineering plan required for works over 25 degrees and notifying the council of any non-compliance incidents within 72 hours of them occurring.

A full copy of the consent and conditions is held by PF Olsen Ltd.

There are no HNZ authorities that apply to Mangamingi Forest.

The Emissions Trading Scheme

Forests in New Zealand are governed by rules related to New Zealand’s Kyoto commitments to reduce the nation’s carbon footprint and contribution to associated climate change.

Mangamingi Forest contains 125.1 hectares of forest that was existing forest as at 31st December 1989. At the time of harvest, these stands will be subject to a deforestation tax equivalent to the tonnes of CO₂ projected to be released from decomposition of the forest at a unit financial value determined by the internationally traded emission units. This tax is payable if the forest is not replanted or, if left to regenerate naturally, does not achieve the regulated heights and stocking densities.

The balance of the forest (811.4 ha) was planted on ‘Kyoto compliant’ land that was vacant as at 31st December 1989. These forest areas have not been registered to participate in the NZ Emissions Trading Scheme and are not subject to the accrual of emissions credits and liabilities under that scheme.

Environmental Code of Practice

All operations carried out on the property should be undertaken to the standards specified in the New Zealand Environmental Code of Practice for Plantation Forestry. This document sets out guidelines which ensure safe and efficient forest operations that meet the requirements of sound and practical environmental management.

Forest Road Engineering Manual

Roading and engineering techniques employed within the forest should conform to the industry best practice as outlined in the New Zealand Forest Owners Association publication, “NZ Forest Road Engineering Manual”, published 2012.

Other relevant legislation

For a comprehensive list of relevant legislation refer to PF Olsen’s EMS. Forest owners can be held liable for breaches of these Acts and may be held responsible for damage to third party property. Appropriate protection should be taken to minimise these risks.

Other relevant legislation includes:

- Animal Welfare Act 1999.
- Biosecurity Act 1993.
- Climate Change Response Act 2002.
- Conservation Act 1987.
- Crown Forest Assets Act 1989.
- Fencing Act 1978.
- Forests Act 1949.
- Forest and Rural Fires Act 1977.
- Forests Amendment Act 1993.
- Forestry Rights Registration Act 1983.
- Freshwater Fisheries Regulations 1983
- Hazardous Substances and New Organisms Act 1996.
- Health in Safety in Employment Act 1992.
- Historic Places Act 1993.
- Injury Prevention, Rehabilitation and Compensation Act 2001.
- New Zealand Forest Accord.
- Noxious Plants Act 1978.
- Pesticides Act 1979.
- Reserves Act 1977.
- Resource Management Act 1991.
- Soil Conservation and River Control Act 1971.
- Trespass Act 1980.
- Wildlife Act 1953.

7. Forest Estate Description

Forest area The net stocked areas have been measured from a map produced by PF Olsen. The estimated net stocked areas of each stand are set out in the following table.

Table 7: Forest area (ha)

Gross area	Net stocked area	Area awaiting restocking	Reserves	Other
1278.9	936.5	169.7	172.7	0

Unproductive areas include stocking gaps, roads and tracks, and other small unplanted areas. Total unproductive area has been derived by subtraction.

Current species The main species grown at Mangamingi Forest is *Pinus radiata* (radiata pine). This species has been chosen to best meet the management objectives set out above and in section 2 given the characteristics of the forest land as described in section 3.

Other species established as productive stands are *Eucalyptus*, *Acacia melanoxylon*, *Cupressus lusitanica*, *Cupressus macrocarpa*, *Pseudotsuga menziesii*, *Cryptomeria japonica* and *Larix decidua*.

Treestocks established in the forest are summarised in the table below:

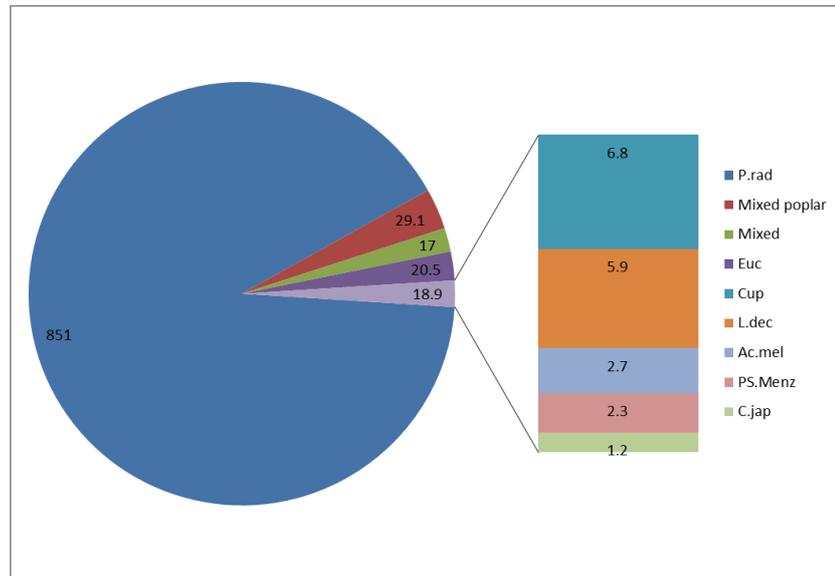
Table 8: Treestock Seedlots

GeoUnit	Species	Year	Seedlot
MNGM-0006-02	P.rad	2012	
MNGM-0006-03	P.rad	2012	
MNGM-0006-04	P.rad	2012	
MNGM-0016-02	P.rad	2011	
MNGM-0016-03	P.rad	2012	
MNGM-0022-02	P.rad	2013	
MNGM-0023-02	P.rad	2013	
MNGM-0023-02	P.rad	2013	
MNGM-0023-03	P.rad	2013	
MNGM-0026-02	P.rad	2010	
MNGM-0027-04	P.rad	2012	
MNGM-0037-02	P.rad	2010	
MNGM-0050-01	P.rad	2010	
MNGM-0051-01	P.rad	2012	
MNGM-0052-01	P.rad	2012	

Species mix

The species mix of Mangamingi Forest is illustrated below:

Figure 1: Species Mix in Mangamingi Forest (hectares).



Productivity indices

The two most common estimators of the productivity of a site are the Site index and 300 index.

Site index is a measure of productivity of a site in terms of height growth of radiata pine at age 20.

The 300 index is a measure of productivity of a site based on stem volume growth (mean annual increment) of 300 stems per hectare.

The site index for Mangamingi Forest is approximately 32.
The 300 index for Mangamingi Forest is approximately 30.

Mangamingi Forest is towards the higher end of site productivity for forestry sites in the general area.

Current crop status

Most remaining older stands in Mangamingi are untended. Data from the most recent inventory (2008) for the one remaining large stand is listed in the table below. While pre-harvest volumes are listed in table 15.

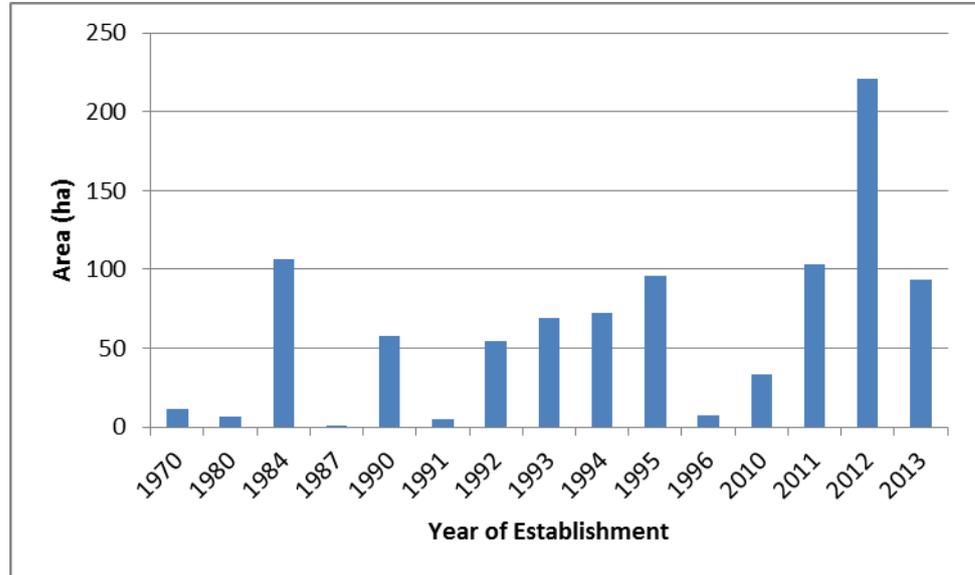
Table 9: Current crop status

Stand	Year planted	NSA (ha)	Total stocking (s/ha)	Basal area (m2/ha)	Mean top Ht (m)	Mean DBH (cm)	Pruned stocking (s/ha)	Pruned height (m)
MNGM-34-01	1992	50.9	286	28	25.6	35.3		

**Age class
distribution**

The age class distribution of Mangamingi Forest is illustrated below. As a result of the ongoing harvest in recent years almost half the stocked forest is under 5 years of age.

Figure 2: Age Class Distribution in Mangamingi Forest



8. Reserve areas and significant species

Introduction

Indigenous biodiversity management in or associated with exotic forests is an essential component of everyday forest management. Although exotic forests can provide a level of biodiversity, the reserve areas are usually the source of most indigenous biodiversity. Rare and threatened species can also be found associated with exotic forests and require special attention for management.

Reserve areas

Mangamingi forest contains a total of 11 protected ecosystem associations in the form of two distinct patches of indigenous forest, three wetlands and various other shrublands, fernlands and manuka areas.

Of the protected areas the wetlands and the associated mixed exotics buffer are relatively important to the general area ecologically. WETL_10 and MEXO_06 are part of an erosion management covenant with the Regulatory Authority Waikato Regional Council, while WETL_11 which is of even better quality is not. The wetlands are fenced and are candidates for restoration work and possible inclusion under QE11 covenants.

While all the indigenous terrestrial areas are protected, all are variously modified from past logging, land clearance and farm related activities and remain disconnected from the nearest large continuous blocks of indigenous forest in the conservation estate on the Paeroa range.

In their modified and fragmented form, the areas in their own right are of moderate to relatively poor condition and lower ecological ranking. However, with only passive protection the remaining areas still have the capacity to regenerate back to full tall forest status, representing an extension of the Paeroa range forests and contributing to an additional level of forest cover in the otherwise heavily depleted Atiamuri Ecological District.

In addition to the protected ecosystems, Mangamingi has numerous stands of planted forest included under soil conservation covenants with Waikato Regional Council. As the areas are assessed they are classified in FIPS and depending on area/cost the aim is to plant most of them with manuka instead of the weedy species currently in these fenced off zones.

The protected ecosystems are shown on the Forest Stands Map in Section 9.

Table 10: Protected ecosystems and reserve areas

Forest	Geo Unit	Area	Reserve Type	Protective Status	Protective Function	HCV Status	Forest Type	LENZ		Ranking	Protection Cat
								Remaining %	Protected %		
MNGM											
1223 Mangamingi											
! CAUTION RARE & THREATENED SPECIES PRESENT IN FOREST !											
	MNGM-WETL-11	11.3	05	Herb'cs Freshwtr Veg SNA	Wetland Ecosystem	No Status	Leptospermum/coprosma/f	0.0	0.0	65536	Special
	MNGM-WETL-09	7.5	05	Herb'cs Freshwtr Veg Management Plan	Wetland Ecosystem	No Status	Leptospermum/coprosma/f	15.3	79.1	65536	Special
	MNGM-WETL-10	3.9	05	Herb'cs Freshwtr Veg Erosion Covenant	Wetland Ecosystem	No Status	Leptospermum/coprosma/f	0.0	0.0	16384	Special
	MNGM-SECF-08	97.2	02	Secondary Forest SNA	Terrestrial Ecosystem	No Status	Tawa/ Broadleaved	15.3	79.1	2048	Limited
	MNGM-MEXO-06	8.0	16	Mxd exotic shrubland Erosion Covenant	Wetland Ecosystem	No Status	Exotic Species	15.3	79.1	512	Limited
	MNGM-SECF-07	7.1	02	Secondary Forest Passive	Terrestrial Ecosystem	No Status	Tawa/ Broadleaved	15.3	79.1	128	Passive
	MNGM-FERN-04	8.6	11	Fernland Passive	Terrestrial Ecosystem	No Status	Broadleaved Hardwood	15.3	79.1	128	Passive
	MNGM-LEPT-05	16.1	13	Manuka_Kanuka Scrub Passive	Terrestrial Ecosystem	No Status	Manuka/kanuka/Broadleav	15.3	79.1	64	Passive
	MNGM-FERN-03	10.6	11	Fernland Passive	Terrestrial Ecosystem	No Status	Broadleaved Hardwood	15.3	79.1	32	Passive
	MNGM-BRDI-01	1.7	15	Broadleaved Hardwoc Management Plan	Terrestrial Ecosystem	No Status	Manuka/kanuka/Broadleav	15.3	79.1	16	Passive
	MNGM-BRDI-02	0.7	15	Broadleaved Hardwoc Management Plan	Terrestrial Ecosystem	No Status	Manuka/kanuka/Broadleav	94.3	70.9	8	Passive
		172.7									
	TOTAL	172.7									

Riparian reserves

A standardised GIS-based stream classification system has been developed specifically for PF Olsen, based on NIWA’s River Environment Classification (REC) and Freshwater Environments of New Zealand (FWENZ) models. Categorisation of each stream reach is done by the physical characteristics of the particular reach, e.g. underlying geology, streambed slope, climate, and reach order. Each stream category corresponds with a set of rules in the EMS that apply to operations occurring near the riparian reserve.

The stream categories within Mangamingi Forest are summarised below:

Table 11: Riparian reserve categories

Category code	Category name	Total length (m)
LLWH	Large, low, wet, hard	8025
LMWH	Large, moderate, wet, hard	4635
MLWH	Medium, low, wet, hard	26995
MLWS	Medium, low, wet, soft	875
MMWH	Medium, moderate, wet, hard	9663
SLWH	Small, low, wet, hard	6117
SMWH	Small, moderate, wet, hard	6274
Total forest stream length (m):		62584

Rare and threatened species

Because of the heavily modified, relatively small and fragmented nature of the protected indigenous ecosystems, the fact that all the forests, exotic and indigenous cover only ephemeral or seasonal flow catchments and the total forest extent is embedded within a pastoral grassland production landscape, the probability of rare and endangered species being present is low.

The New Zealand Falcon is a nationally vulnerable species and was recorded in PF Olsen’s FIPS system as being sighted in Mangamingi Forest on 16 May 2013. Tui are also known to be present and it is expected that the declining native wood pigeon will utilise the habitat periodically as part of a wider home range.

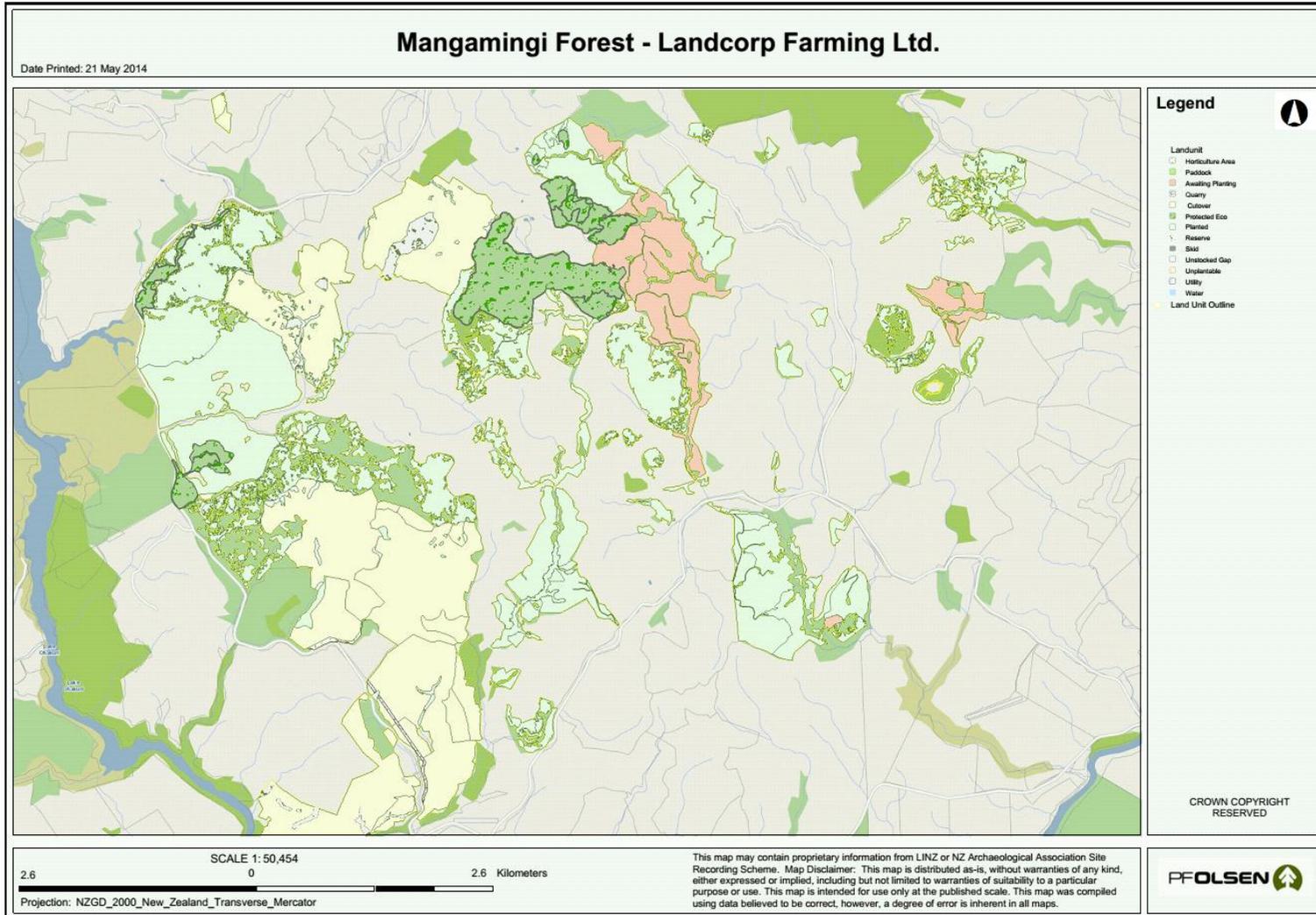
CITES species

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments.

Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 34,000 species of animals and plants.

The full list of New Zealand CITES listed species are available in the EMS, or online at <http://www.doc.govt.nz/about-doc/role/international/endangered-species/cites-species/nz-cites-listed-species/>.

9. Map 2 - Forest Stands Map



10. Forest Products and Other Special Values

Introduction

Forest plantations can provide non-timber forest products and special values that enhance the economic wellbeing of the owner or legitimate forest users. Non-timber products are an important means of maximising the production capacity of the forest whilst maintaining environmental and social values. The forest management plan provides procedures for developing and managing these resources.

Environmental and Social cost-benefit analysis

Forests can deliver numerous social and environmental products, both positive and negative to varying degrees. These non-timber products can be difficult to quantify, unlike financial costs and benefits.

The table below rates the relative positivity and negativity of the more common social and environmental products produced by Mangamingi Forest relative to the most likely alternative primary production system, pastoral drystock farming.

Table 12: Environmental and social cost-benefit analysis

Environmental or social product	Increasingly negative				Neutral			Increasingly positive			
	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5
Soil stabilisation										✓	
Erosion/soil loss				HP							MR
Water quality					HP						MR
Riparian shading			HP								MR
Water quantity					MR		HP				
Carbon sequestration			HP								✓
Native wildlife habitat									✓		
Threatened fauna							✓				
Native fish								✓			
Air quality					HP		MR				
Native reserve protection									✓		
Landscape/visual			HP							MR	
Recreation									✓		
Commercial forest use										✓	
Firewood											HP
Local employment				MR					HP		

NB: where the ratings differ throughout a rotation, 'MR' is used to indicate the mid rotation (growing) stage of the forest, and 'HP' refers to during or post-harvest

Non-timber forest products

There are not currently any non-timber products being produced or developed in Mangamingi Forest.

Other special values

The following special values have also been identified in Mangamingi Forest:

- Beekeeping - This has historically occurred on Mangamingi station.
- Trapping of possums for fur.

Recreational usage

Mangamingi Forest receives high recreational demand from the wider public. Recreational activities undertaken include:

- Hunting- deer and pigs
- Hunt club (on horses)
- 4x4 club events
- Horse trekking
- Walking groups

The forest will continue to be open for legitimate use subject to entry by notification to farm manager. A sign-in system is utilised to ensure hazards are notified and accepted.

11. Environmental Risk Management

Assessment of environmental risks

Several areas of typical forest management have been identified as posing a possible environmental risk within Mangamingi Forest. The Environmental Assessment Matrix below summarises the identified risks for Mangamingi Forest. The level of risk has been evaluated in the matrix as high 'H' or low 'L', or not applicable 'NA'.

Prior to operations such as clearfelling, land preparation and production thinning, an assessment is undertaken to quantify the risk involved in carrying out the particular operation, and steps are implemented to manage the risks.

Table 13: Environmental impacts risk assessment

Forestry Operational Activities	ENVIRONMENTAL VALUES/ISSUES											
	Erosion & Sediment Control	Water Quality	Soil Conservation & Quality	Air Quality	Aquatic Life	Native Wildlife	Native Vegetation	Historical & Cultural Values	Landscape & Visual Values	Neighbours & other forest users	Public Utilities	Recreation Values
Harvesting	H	M	M	L	M	L	L	L	M	H	L	L
Earthworks	H	H	M	L	H	L	L	L	H	L	L	L
Slash Management	H	M	L	L	M	L	L	L	L	L	L	L
Stream Crossings	H	H	L	L	H	L	L	L	L	L	L	L
Mechanical Land Preparation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Burning	L	L	L	H	L	L	L	L	H	H	L	H
Planting	L	L	L	L	L	L	L	L	L	L	L	L
Tending	L	L	L	L	L	L	L	L	L	L	L	L
Fertiliser Application	L	H	L	L	H	L	L	L	L	L	L	L
Agrichemical Use	L	H	L	L	H	L	H	L	L	H	H	H
Oil & Fuel Management	L	H	L	L	H	L	L	L	L	H	L	L
Waste Management	L	L	L	L	L	H	L	L	L	L	L	L
Forest Protection	L	L	L	L	L	L	L	L	L	L	L	L

Hazardous substances management

Hazardous substances are any substances, which may cause adverse environmental impacts and/or injury or health problems if incorrectly handled or used.

The hazardous materials which may be used within Mangamingi Forest are:

- Pesticides;
- Fuels and oils;
- Fire retardants;
- Surfactants.

Transportation, storage and labelling of these hazardous materials must all comply with the provisions of the Health and Safety Manual, which is maintained under ISO 9001 certification and incorporate legislative controls under EPA and NZS 8409:2004 Management of Agrichemicals code of practice.

Furthermore, the forest manager is committed to reducing the use of hazardous substances as much as possible. This involves use of alternative methods for the control of weeds, pests and diseases where these are effective and efficient. The use of fuels and oils is minimised where possible. Fire retardants are only used when required and surfactants are only used to make more efficient use of specific herbicides.

FSC highly hazardous chemicals

There are four agrichemicals that have been classified ‘highly hazardous’ by FSC that are used in forestry and conservation operations within PF Olsen certified forests. Special derogations to continue usage subject to conditions are maintained by PF Olsen.

Table 14: Highly hazardous chemicals used by PF Olsen

Active ingredient	Purpose	Common usage
Terbuthylazine	Gorse and grass control to aid establishment	Once/twice per rotation
Hexazinone	Bracken, grass, pampas and blackberry	Some specific sites
Sodium cyanide	Possum control (ground-based)	Rare
Sodium Monofluoroacetate (1080)	Possum control	Rare; usually by Animal Health Board

12. Commercial Crop Establishment and Silvicultural Operations

Introduction

Forest operations are implemented to ensure a good quality crop and maximum growth. These operations include land preparation, establishment, weed control, pest and disease control, fire protection, pruning and thinning, and general property asset maintenance.

Crop species

In Mangamingi Forest, the main crop species grown Pinus radiata.

Radiata pine, when intensively managed, will produce a range of different log types suitable for various processing options. The pruned butt log can be used to make knot-free veneer or decorative timber. The unpruned logs can be used for structural timber, for veneer or for feedstock for fingerjointing. The small logs and those with defects and excessive knots can be used for pulp and paper, MDF and other reconstituted wood products such as tri-board and particle board.

Radiata pine is the most common species processed in New Zealand and export markets are well developed for both finished products and logs.

In New Zealand radiata pine is also the main focus in terms of research and development. Past research and development has resulted in improvements in growth, form and wood characteristics as well as development of a range of finished products, building codes and timber standards.

Other species established as productive stands are Eucalyptus, Acacia melanoxylon, Cupressus lusitanica, C.macrocarpa and Cryptomeria japonica. Most have not been well tended so performance is variable.

Species established in soil conservation areas include the above species plus larch, Douglas fir, poplars and willows. These species will be incorporated into the managed stand records system over the duration of this plan.

Alternative species have been considered, but these did not meet the Landcorp Farming Ltd objectives.

Establishment

The establishment planned at Mangamingi Forest during the period of this management plan includes replanting of any harvested areas and the planting of some soil conservation areas in manuka.

Re-establishment will aim to use high quality treestocks suitable for the site and market. These will be investigated at time of establishment.

Pre-establishment forest flora and fauna

Prior to re-establishment of the tree crop, a review will be conducted to identify whether there are any rare, threatened or endangered species of flora or fauna within the area to be planted and what, if any, adjustments in planning may be required. This may include the extension of an existing wildlife corridor or riparian area by increasing setbacks at the time of crop replanting. A plantation crop is likely to confer beneficial habitat buffering rather than cause adverse effects.

These considerations are covered by the afforestation checklist and riparian rules contained within the EMS.

Tending

The tending regime executed at Mangamingi Forest is mainly a framing regime. However, trees along fence lines and some of the smaller stands are pruned. The pruning of trees along fence lines and thinning of all stands for the framing regime will continue through the duration of this plan.

Tree nutrition

The soils in Mangamingi Forest are not likely to be deficient in nutrients for healthy tree growth. However, there are soils within New Zealand that are deficient in one or more nutrients. The most common nutrient deficiencies are likely to be:

- **Magnesium** – Magnesium deficiency is a particular problem of the Central North Island and is associated with the phenomenon known as mid crown yellowing where the middle of the tree crown turns a yellow colour. Heavily pruned trees and some seedlots are more predisposed to the deficiency than others.
- **Boron** – Boron deficient trees can suffer dieback from the terminal buds and this symptom is closely associated with moisture stress and drought. Trees growing on the drier East Coast of both Islands and on the pumice soils of the Central North Island are prone to boron deficiency.

Foliar samples will be taken if nutrient deficiency symptoms are seen or expected. Fertiliser will only be applied if the health and the growth of the trees are significantly affected.

13. Forest Inventory, Mapping and Forest Records

Inventory

Forest growth and development is monitored through forest inventory. Forest inventories providing stand information are required at different times and for different reasons throughout the life of the rotation. PF Olsen have procedures for each of the following four types of inventory to be applied on Mangamingi Forest:

- Pre-assessment: for silviculture rate setting and validating operational timing vs silvicultural targets;
 - Quality control: to check contractor’s performance and update stand records;
 - Mid crop: to collect measurement inputs for growth modelling;
 - Pre-harvest: to obtain estimates of recovery by log grade.
-

Mapping

Digital mapping of Mangamingi Forest currently exists, but will require updating from time to time as the forest changes.

The digital data is retained, processed and managed on PF Olsen’s GIS (Geographic Information System) to an accuracy fit for purpose.

Stands are remapped from new aerial photography around age four (when the trees are visible on aerial photography) to accurately determine boundaries and areas and around two years prior to harvesting to assist with harvest planning.

Forest records

Forest records are essential in monitoring the forest operations by providing a historic perspective to the physical condition of each stand.

Mangamingi Forest records are maintained on PF Olsen’s FIPS system (Forest Information and Planning System). These record systems allow for fast retrieval of information, production of reports and statistics and provide a comprehensive audit trail.

Forest records are essential to understand the status and condition of forest stands, reserves, and important fauna species as well as the retention of inventory data and operation monitoring data.

14. Harvesting Strategy and Operations

Harvesting strategy As a plantation with a non-normalised age-class structure, the harvesting strategy employed at Mangamingi Forest is to harvest the forest or constituent stands as close as possible to the optimum economic age as practical. This is the age at which the growth in volume and improvement in quality is offset by the cost to maintain the forest for another year. The optimum rotation length (for radiata pine) is expected to be within 25 to 30 years (this may be less for framing or unpruned stands).

Of importance in this assessment is the actual growth of the tree crop, the market for the wood at the time of the harvest and the outlook then and for the near future. These factors, together with logistics such as the availability of suitable harvest contractors and the requirements of resource consents, will determine the actual harvest time.

Getting harvest ready Forward planning is essential when considering harvesting activities. Harvest planning is conducted within a detailed structured framework controlled within the PF Olsen FIPS system. Planners are guided through a total of 100 elements involving environmental, cultural, community, infrastructural, and safety issues that must be addressed as well as direct operational and economic considerations, prior to the issuing of final prescriptions.

Harvest planning has been undertaken for the remaining large stands within Mangamingi forest and these will be harvested over the period of this plan. Infrastructure is now being constructed and all consents are in place.

Harvesting operations are undertaken by contractor and supervised by the forest manager.

Current harvest Harvesting has been underway over the period of the last plan and is programmed to continue. The level of harvest will be market dependant and working more-or-less sequentially through the stand age-classes from oldest to youngest. By the end of the period of this plan, most of the first rotation commercial plantations will have been harvested and replanted in Mangamingi.

The approximate proposed harvest schedule is tabulated below.

Table 15: Harvest schedule 2014 - 2019

Year	Cpt/Std	System	Est. Yr	Age	Area (ha)	Tonnes/ha (t/ha)	Total Tonnes (Tt)	Duration (days)
July 2014	33/01	CF - HL	1992	22	26.5	425	11,263	70
	30/01	CF - HL	1990	24	14.1	600	8,460	53
2015	30/01	CF - HL	1990	25	43.3	600	25,980	162
	910/01	CF - HL	1984	31	13.9	500	6,950	43
	33/01	CF-P	1992	23	17.6	425	7,480	34
2016	34/01	CF-P	1993	23	49.0	425	20,825	95
	35/01	CF-HL	1993	23	18.1	500	9,050	57
	18/01	CF-RL/HL	1994	22	4.5	550	2,475	17
	18/02	CF-RL/HL	1994	22	22.0	480	10,560	70
2017	18/02	CF-RL/HL	1994	23	9.4	480	4,512	30
	28/01	CF-RL/HL	1994	23	36.5	500	18,250	122
	20/01	CF-RL/HL	1995	22	23.0	560	12,880	86
2018	20/01	CF-RL/HL	1995	23	20.6	560	11,536	77
	19/01	CF-RL/HL	1995	23	44.5	550	24,475	163
2019	19/01	CF-RL/HL	1995	24	6.3	550	3,465	23
	various small stands > 8ha size	CF-RL/HL	various	various	39.5	500	19,750	132
TOTALS:					388.8		197,911	

15. Property Management and Protection

Statutory pest obligations

Pest management within Mangamingi Forest is subject to statutory obligations under the Regional Pest Management Strategy administered by the Waikato Regional Council.

The Strategy applies to both pest plants and animals and categorises them in terms of management objectives. The categories and landowner obligations are summarised in the table below.

Table 16: Statutory pest regulations

<i>Plant and Animal Pest Categories- Waikato Regional Pest Management Strategy</i>		
Pest Category	Pest objectives	Forest Landowner Obligations
Eradication Pest	Pests of limited distribution where reduction of pests to zero density is possible.	Landowner must not knowingly spread pest or hinder control. WRC will fund and implement appropriate control programmes for these pests
Containment Pest	Pests which are abundant in suitable habitats in the region. Goal may be to contain density of pest to within its range or prevent spread to neighbours and other parts of region.	WRC will develop and enforce rules requiring land occupiers to control the pests in a variety of circumstances. WRC may also undertake service delivery of some containment pests in specific areas.
Potential Pest	Pests which have a high potential threat to the region where there is no strategy rule requiring the land occupier to control the pest.	WRC will undertake surveys. Control may be warranted at an early stage and would be undertaken by WRC, not the land occupier.
<p>Plant pests- Full details of classifications and obligations of plant pests are listed in Chapter 5 of the Pest Management Strategy. Animal pests- Full details of classifications and obligations of plant pests are listed in Chapter 6 of the Pest Management Strategy.</p> <p><i>The full list of plant and animal pest species covered by the Waikato Regional Pest Management Strategy are contained in Appendix 2</i></p>		

Pest control

The PF Olsen Integrated Pest Management provides guidance on application and execution of the PF Olsen Ltd Environmental Management System (EMS) for pest control and chemical use.

The main animal pest in Mangamingi Forest is the introduced possum. Possums attack the growing tips of both plantation and native trees, causing stem malformation and die back. Possums are also a threat to neighbouring property owners who are farmers as they can carry and spread tuberculosis to domestic stock.

Other pests include rabbits and hares at the time of establishment and wild goats during the first half of the crop rotation when bark is soft and palatable.

Possum control is currently being completed on Mangamingi station by the Animal Health Board. An initial 1080 drop was completed, and ongoing control using Cholecalciferol gel bait is to be maintained. This ground baiting method will be the preferred option in the immediate future as FSC derogations on use of 1080 restrict aerial application methods to the land (by any party) to emergency situations.

Animal pests in Mangamingi Forest will be controlled using ground control methods as required, which prevent impacts on non-target species. The forest manager will coordinate operations with organisations such as the Regional Council and the Department of Conservation to achieve effective and efficient control within the forest area and on neighbouring land, where required.

Forest plant pests are low on this estate because of the grazing that restricts plant spread and development of such things as pampas. However there are wilding pines present within the protected ecosystems and these are being addressed.

Disease control

Diseases, which can affect the forest trees and adjacent native vegetation, are monitored throughout the year by the forest manager, and once a year by a professional independent forest health assessor. Most diseases cause little damage and do not require control. The exception is *Dothistroma*, a fungus which attacks pine needles. This fungus is controlled using a copper-based fungicide, but only when the infection reaches a critical level.

Dothistroma infection can also be controlled through silviculture by timely thinning and pruning operations, which increases air movement and lowers humidity levels.

Depending on the results of the annual infection inspections there may be a need for *Dothistroma* control to take place in Mangamingi Forest.

Protected ecosystems, reserves and species

PF Olsen’s Conservation and Ecology Manual provides detailed guidance and specification on the application and execution of ecological management targets and actions, as are broadly laid out in the Environmental Management System (EMS). Programs for ecological management are specified and monitored in FIPS Ecological Management module.

The nature of the forest type associations regenerating at Mangamingi mean that with only quite basic management strategies the forests can, over extended periods of time, be expected to return to healthy examples of forest types that were widespread in the locality. The primary management actions required are;

1. Maintenance of complete stock proof fencing.
2. Maintenance of low goat numbers.
3. Maintenance of low possum populations through use of Pindone baiting.
4. A steady programme of wilding pine poisoning or felling until the indigenous stands are clear of them.
5. Basic photo-point monitoring to demonstrate improvement over time.

All these actions will be implemented or maintained over the period of this plan.

**Ecological
equivalence**

Mangamingi is a large Forest as defined under the FSC NZ Standard. By these definitions the forest is required to have the equivalent of 5% of its productive area under protection and the FSC estates within the Group Scheme must, in aggregate, achieve a level of 10% of the certified estate within each Ecological District also under protection.

Where such thresholds cannot be met, there are other mechanisms generally termed ‘ecological equivalence actions’ that can be undertaken to meet the standard.

Mangamingi has 13.5% of its total managed area as reserves thus exceeding the 5% internal threshold.

Mangamingi falls into the Atiamuri ecological district which has an aggregated total of reserves across the Group Scheme forests in the ED of 8.9% (22.4 hectare shortfall).

	>1000 ha (L)	<1000 ha (SLIMF)
Forest Size	Y	
Meets 5% internal threshold	Y	
10% Ecological District Requirement		
- Met within forest	N	
- Met within eco district	Y	
- Met by eco district adjacency eco equivalence effort.	-	
- Met by eco region adjacency eco equivalence effort.	-	

Under the FSC NZ Standard shortfalls in reserve area can be made up by an ‘ecological equivalence’ investment into other protected ecosystems within the estate, or in other parts of the estate in other Ecological Districts or in other party’s lands within the Ecological District. The ‘ecological equivalence’ value has been benchmarked and calculated against the average annual spend of the Department of Conservations 2013 Annual report and would amount to just under \$150/annum.

This amount is already being substantially exceeded by the combined inputs to a wetland restoration project in an adjacent forest (TeToke), in the same ED.

Fire prevention and control

With the weather patterns normally experienced in New Zealand during the period late spring/summer, fire can be a real threat to the forest. This can be minimised by:

1. Having an effective fire plan;
 2. Active prevention measures which include restrictions on allowable access, fire prevention signage, publicity when fire danger prevails, access to adequate water sources, constructing and maintaining firebreaks, and selective forest grazing to reduce fuel within stands;
 3. Effective detection systems which includes good communication systems, mapping, and fire plan alert procedures;
 4. A close link with the relevant fire authorities, and an understanding of equipment and trained manpower requirements, and
 5. Good forest management that recognises the influence of terrain, roading network and accessibility, and fuel build-up from silvicultural practice, that will influence fire prevention and control measures.
-

Fire authority responsibilities

The legal responsibility for fighting forest fires lies with the respective territorial land authorities where the forest is situated. In the case of Mangamingi Forest the Rural Fire Authority (RFA) is the Punicelands Rural Fire Authority.

In the event of a fire that starts within the forest, the RFA is responsible for attending and providing the resources to extinguish the fire. Where a fire starts outside the forested area and moves into the forest, the RFA has recourse to the Rural Fire Fighting Fund to compensate for fire fighting costs.

There is a close liaison with the RFA in terms of developing the 'fire plan' and the maintenance of good communication relative to potential risks and fire danger ratings.

Fire insurance

With regard to the location of the forest and the high public activity around the fringes, there will always be the potential for fire. If a fire originates within the forest, the owners will ultimately be liable for suppression costs. A major fire may cost many thousands of dollars to extinguish, with the main costs being the use of heavy machinery, helicopters, and manpower.

In the case of Mangamingi Forest, Lancorp Farming Ltd have

**Public liability
insurance**

It is recommended that Landcorp Farming Ltd maintain public liability insurance cover, with a fire fighting extension, to indemnify against unforeseen adverse activity both within the forest area and adjoining land tenure. In the case of fire spreading from Mangamingi Forest onto adjoining land, Landcorp Farming Ltd would be liable for the fire fighting costs and any damage to property.

Landcorp Farming Ltd hold general indemnity insurance with a fire-fighting extension.

16. Monitoring

Introduction

To ensure that the management objectives identified in this plan are being achieved, various monitoring exercises outside normal operations management have been developed. Monitoring results are summarised and reported to Landcorp Farming Ltd as and when required and are also, where appropriate, made publicly available through the PF Olsen webpage.

Values monitored

Management inspections are completed regularly during operations and periodically between times to monitor all aspects of the forest growth, health and conditions. The findings of the inspections are detailed and, where appropriate, summarised on the PF Olsen FSC website. The full monitoring framework implemented and applicable to Mangamingi Forest is tabulated below.

Environmental Process Monitoring Framework					
Monitored Element	Include √	Components	Data Source	Data medium	Reporting / Website frequency
Chemical usage	√	A.I usage/ Area overuse	operations supervisors	FIPS Form	On demand / annual
Consultation activity	√	Complaints	operations supervisors & planners	Form	Annual / annual
Environmental incidents	√	Incident number / categories	operations supervisors	FIPS Form	On demand / annual
Flora & fauna	√	Species & Status frequencies/ new finds	operations supervisors, public, crews	FIPS Form	Annual / annual
Forest estate structure	√	Area (plantation & Protected ecosystem)/ age-class/ species/forest type/protection status	management plans/stand records	FIPS stand records	On demand / annual
Forest growth	√	PSP protocols / periodic inventory. ISO 9001	contractors	To be established	Periodic-annual – not on web
Forest health	√	Disease & health	National Forest surveillance program ³	document	Periodic-annual – not on web

Continued on next page...

³ Forest health inspections are undertaken annually, by an independent specialist forest health assessor, through the NZ Forest Owners Association forest health scheme.

...continued

FSC membership	√	Block/ location/name	FIPS register	FIPS client database	On demand / annual
Health and safety statistics	√	LTI / accidents & incidents.	operations supervisors	FIPS	Monthly/ annual
Internal Audit CAR activity	√	Frequency * category	Auditors/ees	FIPS Form	Annual / annual
Log production	On harvest	Total logs/ FSC markets	log docketts	Woodtrack	On demand / annual
Operational monitoring	√	Audit trends/cause analysis	operations supervisors	FIPS Form	Monthly / annual
Pests	√	RTC / kill returns or other	supervisors /contractors	To be established	Annual where relevant
Protected ecosystem condition	√	Condition trends/photopoint monitoring	Contractors/ supervisors	To be established	Bi-annual if restoration initiated
High Conservation Value forests	NA	Condition trends/photopoint monitoring	Contractors/ supervisors	To be established	Bi-annual if restoration initiated
Recreational & non-timber	√	Permits issued	branch offices / forest security	FIPS Form	Annual / annual
Resource consents	√	Number/compliance	operations planners	FIPS	6 monthly / annual
Stream monitoring	NA	Clarity +/- other specific	supervisors /contractors	Spreadsheet	Monthly / annual where relevant
Environmental training	√	Courses, numbers, names	Staff	FIPS Form	Annual/as relevant
Client satisfaction	√	Post-operation client survey	clients	Survey form	Post-operational /annual
Social survey	√	Demographics, values, work conditions	contractors	Survey form	5 yearly/annual

Financial

Budget versus expenditure is monitored through the PF Olsen FIPS system and presented to Landcorp Farming Ltd when requested. This information is not made public.

Social

Consultation with stakeholders has been undertaken and constant feedback from these stakeholders (and others as they become apparent) is monitored. This includes actions undertaken to resolves disputes and issues.

17. Future Planning

Introduction

This plan pertains to the management of Mangamingi Forest and will be adhered to for the next 5 years. Any deviation from this plan will be justified only on the basis that the changes do not adversely affect the environment. Any changes which are contrary to the policies contained in this management plan require a full review of this plan.

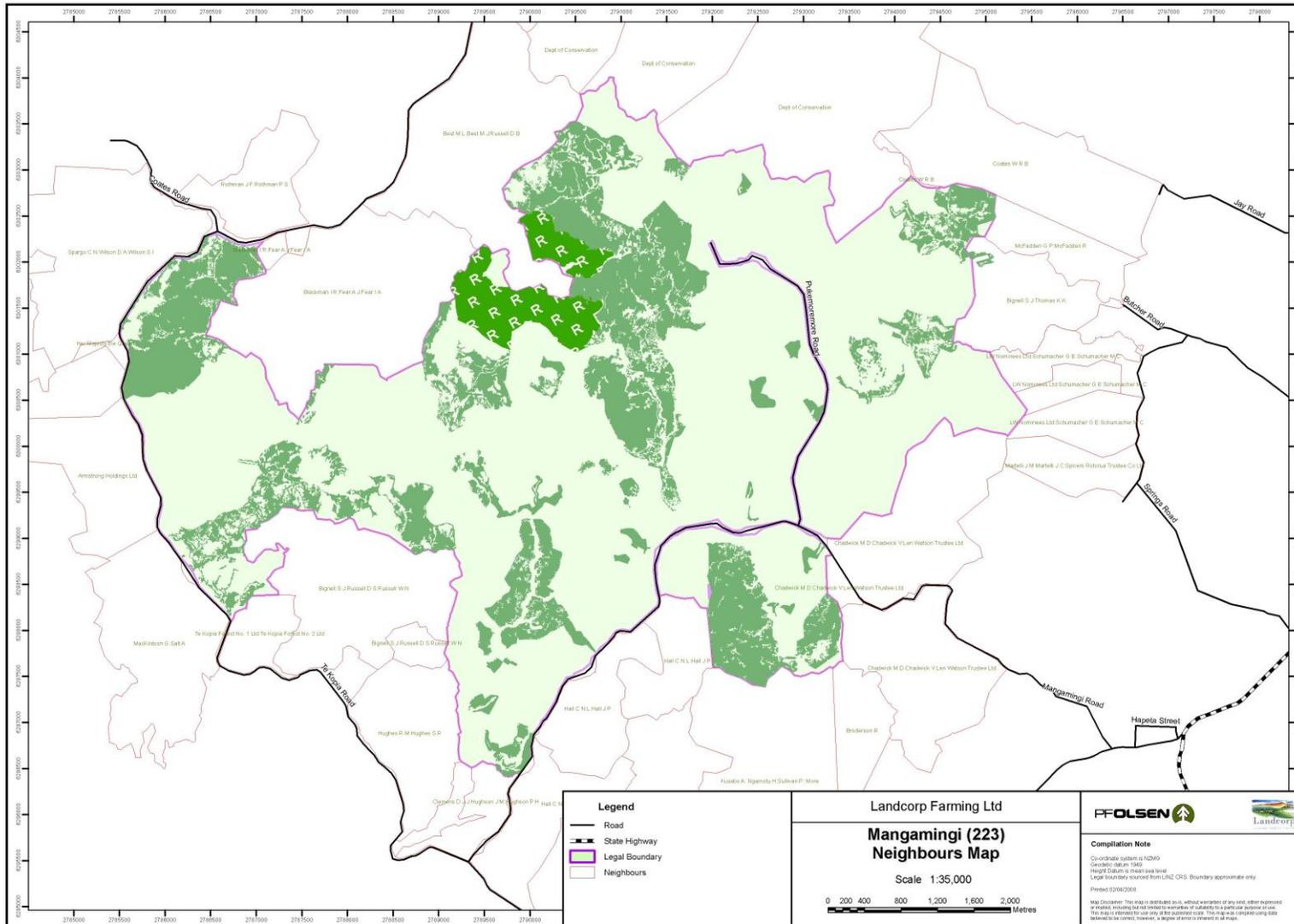
The next review date for this plan is June 2019.

The forest management plan is used for both medium and long term planning.

Operation plans

For the short term we use operation plans. These plans are prepared annually in accordance with this management plan. This operation plan and associated budget are subject to approval by Landcorp Farming Ltd at the beginning of each financial year.

Appendix 1: Neighbours Location Map



Appendix 2: Waikato Regional Pest Management Strategy

Plant pest management

The RPMS identifies management programmes for 59 plant pests in three pest categories that warrant some level of regional intervention:

Eradication plant pests

Waikato Regional Council will directly manage and control these 15 plants or classes of plants⁴. The Council will also undertake monitoring of these pests and provide information to the community on identification of the pests and progress of control.

- African feather grass (*Pennisetum macrourum*)
- Alligator weed (*Alternanthera philoxeroides*)
- Cathedral bells (*Cobaea scandens*)
- Climbing spindleberry (*Celastrus orbiculatus*)
- Evergreen buckthorn (*Rhamnus alaternus*)
- Japanese knotweed and giant knotweed (*Fallopia japonica* and *Fallopia sachalinensis*)
- Manchurian wild rice (*Zizania latifolia*)
- Mile-a-minute (*Dipogon lignosus*)
- Nassella tussock and fine stemmed needle grass ('Mexican feather grass') (*Nassella trichotoma* and *N. tenuissima*)
- Noogoora bur (*Xanthium strumarium*)
- Old man's beard (*Clematis vitalba*)
- Senegal tea (*Gymnocoronis spilanthoides*)
- Spartina¹ (*Spartina species and hybrids*)
- Variegated thistle (*Silybum marianum*)
- White bryony (*Bryonia cretica*)

⁴ DOC is the lead agency for spartina control.

Containment plant pests

The table below summarises 23 plants or classes of pests which land occupiers are responsible for controlling under Strategy rules. The Council monitors all these pests and will provide information and advice when required.

Containment pest plants	Strategy rules		Other council assistance	
	Total control	Boundary control	Biological control	Direct control (discretionary)
Australian sedge (<i>Carex longebrachiata</i>)		√ (20 metres)		√
Banana passionfruit (<i>Passiflora tripartita</i> and <i>P. mixta</i>)	√			√
Boneseed (<i>Chrysanthemoides monilifera</i> ssp. <i>monilifera</i>)	√		√	√
Broom (<i>Cytisus scoparius</i>)		√ (20 metres)	√	√
Climbing asparagus (<i>Asparagus scandens</i>)	√			√
Darwin's barberry (<i>Berberis darwinii</i>)	√			√
Gorse (<i>Ulex europaeus</i>)		√ (20 metres)	√	
Mexican devil (<i>Ageratina adenophora</i>)	√ ⁵			√
Mignonette vine (<i>Anredera cordifolia</i>)	√			√
Mistflower (<i>Ageratina riparia</i>)	√ ⁶		√	
Moth plant (<i>Araujia sericifera</i>)	√			√
Nodding and plumeless thistle (<i>Carduus nutans</i> and <i>C. acanthoides</i>)	√ ⁷	√ (50 metres)	√	
Pampas (<i>Cortaderia jubata</i> , <i>C. selloana</i> and cultivars)	√ ⁸			√
Pinus contorta (<i>Pinus contorta</i>)	√		√	√
Privet (Chinese and tree privet) (<i>Ligustrum</i> species)	√ ⁹			√

⁵ Excluding Thames Coromandel area.

⁶ Excluding Thames Coromandel area.

⁷ Total control in intensively farmed areas, boundary control in less intensive areas. See RPMS for maps of areas.

⁸ Total control in parts of region only (Taupo, Rotorua, South Waikato, Matamata Piako, Waipa and parts of Otorohanga, Waitomo and Hauraki districts). See RPMS for map of total control area.

⁹ Total control where the Council receives a valid health related complaint from occupier living or working within 50 metres of the privet. Total control on roadsides and rail corridors.

Containment pest plants	Strategy rules		Other council assistance	
	Total control	Boundary control	Biological control	Direct control (discretionary)
Purple nutsedge (<i>Cyperus rotundus</i>)	√			
Ragwort (<i>Senecio jacobaea</i> and <i>Jacobaea vulgaris</i>)	√ ¹⁰		√	
Taiwan cherry and rum cherry (<i>Prunus campanulata</i> and <i>P. serotina</i>)	√ ¹¹			√
Tutsan (<i>Hypericum androsaemum</i>)		√ (20 metres)		√
Wild ginger (kahili and yellow) (<i>Hedychium gardnerianum</i> and <i>H. flavescens</i>)	√			√
Willow (grey and crack) (<i>Salix cinerea</i> and <i>S. fragilis</i>)				√
Woolly nightshade (<i>Solanum mauritianum</i>)	√		√	√
Yellow flag iris (<i>Iris pseudacorus</i>)	√			√

Potential plant pests

A number of plant pests could potentially become invasive weeds in the Waikato Region. Some of the plants are not yet known in the region, while others have limited distributions. More information is required to make informed decisions about their effects on the environment.

- Bushy asparagus (*Asparagus aethiopicus* excluding 'Foxtail' cultivar)
- Californian bulrush (*Schoenoplectus californicus*)
- Chilean flame creeper (*Tropaeolum speciosum*)
- Chilean rhubarb (*Gunnera tinctoria* and *G. manicata*)
- Chocolate vine (*Akebia quinata*)
- Freshwater eel grass (*Vallisneria gigantea*, *V. spiralis*)
- Fringed water lily (*Nymphoides peltata*)
- Hawkweed (*Hieracium pilosella*)
- Horse nettle (*Solanum carolinense*)
- Horsetail (*Equisetum species*)

¹⁰ Total control in intensively farmed areas, boundary control in less intensive areas. See RPMS for maps of areas.

¹¹ Total control where plants are likely to be acting as a seed source for wild seedlings.

- Hydrilla (*Hydrilla verticillata*)
- Kudzu vine (*Pueraria montana*)
- Marshwort (*Nymphoides geminata*)
- Mexican water lily (*Nymphaea mexicana*)
- Monkey apple tree (*Syzygium smithii* also known as *Acmena smithii*)
- Mouse-eared hawkweed (*Hieracium pilosella* and *Pilosella officinarum*)
- Purple loosestrife (*Lythrum salicaria*)
- Reed sweetgrass (*Glyceria maxima*)
- Saltwater paspalum (*Paspalum vaginatum*)
- Rhododendron ponticum (*Rhododendron ponticum*)
- Sagittaria (all *Sagittaria* species – except *S. subulata* in Lake Waahi only)
- Water poppy (*Hydrocleys nymphoides*)

Animal pest management

Eradication and containment animal pests

The table below summarises 22 animals, or classes of animal pests, which the Council and land occupiers are responsible for controlling under the production threat, public threat (affecting human health) and environmental threat pest groups.

Animal pests	Means of achievement			
	Strategy rules	Production threat	Environmental threat	Public threat
Dama wallaby (<i>Macropus eugenii</i>)	y	√	√	
Feral cat (<i>Felis catus</i>)	y		√	√
Wild deer (<i>Cervus</i> and <i>Dama</i> species)	n	√	√	
Feral goat (<i>Capra hircus</i>)	y	√	√	
Feral pig (<i>Sus scrofa</i>)	n	√	√	
Hedgehog (European) (<i>Erinaceus europaeus</i>)	y		√	
Mustelids – ferret, stoat, weasel (<i>Mustela furo</i>), (<i>Mustela erminea</i>) and (<i>Mustela nivalis vulgaris</i>)	y	√	√	
Possum (<i>Trichosurus vulpecula</i>)	y	√	√	
Rabbit (<i>Oryctolagus cuniculus</i>)	y	√	√	
Rat Ship rat (<i>Rattus rattus</i>), Norway rat (<i>Rattus norvegicus</i>)	y	√	√	√
Magpie (<i>Gymnorhina tibicen</i>)	y		√	√
Rainbow lorikeet (<i>T. haematodus</i>)	y		√	
Rook (<i>Corvus frugilegis</i>)	y	√		
Brown bullhead catfish (<i>A. nebulosus</i>)	y		√	
Koi carp (<i>Cyprinus carpio</i>)	y		√	
Gambusia (<i>Gambusia affinis</i>)	y		√	
Wild goldfish (<i>Carassius auratus</i>)	y		√	
Perch (<i>Perca fluviatilis</i>)	y		√	

Animal pests	Means of achievement			
	Strategy rules	Production threat	Environmental threat	Public threat
Tench (<i>Tinca tinca</i>)	y		√	
Rudd (<i>Scardinius erythrophthalmus</i>)	y		√	
Asian paper wasp (<i>Polistes chinensis</i>)	y	√	√	√
Australian paper wasp (<i>Polistes humilis</i>)	y	√	√	√
Common wasp (<i>Vespula vulgaris</i>)	y	√	√	√
German wasp (<i>Vespula germanica</i>)	y	√	√	√
*Lesser banded hornet (<i>Vespa affinis</i>)	n	√	√	
*Median wasp (<i>Dolichovespula media</i>)	n		√	√
*Yellow flower wasp (<i>Radumeris tasmaniensis</i>)	n		√	√
Argentine ant (<i>Linepithema humile</i>)	n		√	√
*Darwin's ant ¹² (<i>Doleromyrma darwiniana</i>)	n		√	√
*Little fire ant (<i>W. auropunctata</i>)	n	√	√	√
*Red imported fire ant (<i>S. invicta</i>)	n	√	√	√
*Tropical fire ant (<i>S. geminata</i>)	n	√	√	√
*Yellow crazy ant (<i>A. gracilipes</i>)	n	√		

* Although these ant species are not yet in the Waikato region, they are harmful animals that could have considerable negative impacts on the region's biodiversity.

¹² The first population recorded in Auckland in 1959 was eradicated, but the species is now established in Christchurch and additional populations are known from the northern and eastern North Island and the northern South Island.