Local Environmental Benefits Report

Proposed pine plantation – Lot 12667 (No. 7691) Muir Highway, Frankland River

Ian Dumbrell

2/10/2025

Scope

As agreed between the Shire of Cranbrook and the Proponent, this report will identify:

(i) any environmental benefits to the property, and any environmental benefits consequential thereon, that will be associated with the plantation, including, where applicable, but not limited to, those matters outlined in clause 10.3 of the *Shire of Cranbrook Local Planning Policy No 1 – Plantations* (LPP1); and,

(ii) any environmental disbenefits that may be associated with the plantation, including whether any change to the water table may have an adverse impact on the Cobertup Swamp and, consequential upon that adverse impact, also have an adverse impact on any other water bodies.

In relation to (i) and (ii) above, this independent and objective expert report will be restricted to assessing the use of fertilisers and chemicals when comparing the proposed pine plantation with a well-managed agricultural property in terms of environmental benefits and disbenefits. Therefore, whether there are any potential water table changes will not be assessed, but water quality will be addressed.

Method

Commercial forest management in Australia is governed by codes of practice (eg,the Code of Practice for Timber Plantations in WA) and 'Standards' (Australian Forestry Standard, Forest Stewardship Council) to which they are independently audited and certified. Certification is not compulsory but is generally required by customers, particularly when selling products overseas. To my knowledge, farm management is not governed by codes of practice or Standards.

Therefore, when comparing chemical and fertiliser use between well managed farmland and a commercial forest plantation, I will use the Forest Stewardship Council[1] (strictest) Standard applicable to forest plantations as a benchmark. The FSC Standard includes a regularly updated Highly Hazardous Pesticides list (FSC-POL-30-001a EN, 2019). FSC takes into account the toxic characteristics for humans and the environment of chemical pesticides and identifies highly hazardous pesticides using internationally recognized hazard groups and criteria, and the associated indicators and thresholds listed in Annex 1 of the FSC Pesticides Policy.

The most sensitive environmental factor that may be impacted by fertiliser and chemical inputs to a farming or tree plantation venture is water quality. Water quality can affect a range of animal and plant species in an ecosystem. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) will be used as a reference for assessing water quality impacts.

The area is currently not gazetted as a Public Drinking Water Source Area (PDWSA) but when assessing potential impacts on water quality, the guidelines governing PDWSA landuse and

---

[1] The Forest Stewardship Council (FSC) is an international, non-governmental organisation dedicated to promoting responsible management of the world's forests. Since its foundation in 1994, FSC has grown to become the world's most respected and widespread forest certification system.

chemical use will also be used as a benchmark to ensure the most beneficial outcome. These guidelines are particularly useful when assessing buffer zones. The Department of Water and Environmental Regulation (DWER) Water Quality Protection Note 25 *Land use compatibility tables for public drinking water source areas* and Water Quality Protection Note 121 *Plantations in public drinking water source areas* as well as the Department of Health's Circular No PSC88 *Use of herbicides in water catchment areas* will be used.

Assessment of the pine plantation will be based on the proponent's information as outlined in their Management Plan[2], prepared by Delta Forestry Pty Ltd. Assessment of Well Managed Farmland will be based on the current grazing inputs (fertiliser and pesticides) as well as a Canola cropping system as an approved alternate farming venture. While the land is currently grazed the Shire of Cranbrook's Local Planning Policy 1 – Plantations clause 10.1 Continuing Agricultural Activities, states that 'Traditional agricultural activities such as cropping, grazing and food production should generally remain the predominant land use with plantations as an ancillary and complementary use'. Therefore, I am working on the basis that the land owner could establish a canola crop without requiring Cranbrook Shire approval.

Assessing the Environmental Benefits and Disbenefits will use a "Weight of Evidence" approach. Weight of evidence describes the process to collect, analyse and evaluate a combination of different qualitative, semi-quantitative or quantitative lines of evidence to make an overall assessment of water/sediment quality and its associated management. It is the central platform for water/sediment quality assessments in the Water Quality Guidelines (ANZG 2018).

Applying a weight-of-evidence process incorporates judgements about the quality, quantity, relevance and congruence of the data contained in the different lines of evidence (ANZG 2018).

[2] the Forest Management Plan referred to is the version as amended by orders of the Tribunal dated 14.3.25 and 1.5.25, as further amended by the plan titled 'Development Application' dated May 2025 showing the proposed native species revegetation.

Assessment

Fertiliser Input

Nitrogen (N) and phosphorus (P) are needed nutrients for plant growth, usually in greater quantities than other nutrients. Plants obtain the bulk of their supply of N and P from the soil. In perennial crops such as tree plantations and pastures, periodic additions of N and P are required as the trees grow or as the pastures are consumed by stock. In annual crops such as Canola annual additions of N and P are required to replace nutrient lost through harvest of the crop. In aquatic environments N and P together support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and other organisms that live in water. Excess N and P in aquatic systems can stimulate production of plant (including algae and vascular plants) and microbial biomass, which leads to depletion of dissolved oxygen, reduced transparency, and changes in biotic community composition -- this is called eutrophication. In addition to the impacts on aquatic life, excess nutrients can also degrade aesthetics of recreational waters, and increase the incidence of harmful algal blooms, which may endanger human health through the production of toxins that can contaminate recreational and drinking water resources (USEPA 2015).

Table 1: Elemental nutrient inputs from fertilisers for each different relevant landuse.

	Establishment (year 1)		Maintenance		Cumulative (30 years)	
Landuse	N kg/ha	P kg/ha	N kg/ha	P kg/ha	N kg/ha	P kg/ha
Pasture				5.3		159
Pasture Hay			51	5.3	1530	159
Canola	80	7			2400	210
Plantation	29.7[1]	33.3[1]	192[2]	60[2]	221.7	93.3

1. Based on the higher rate of 150g DiAmmonium Phosphate (DAP – 18% N, 20.2% P) per tree applied to the highest stocking 1100 trees/ha
2. Maintenance based on one application of 300 kg DAP/ha early in the rotation and one application of 300 kg Urea mid-rotation.

The plantation rates were taken from the Plantation Management Plan

The pasture and hay maintenance values are annual inputs as supplied by the landowner as current practice.

Rates for Canola were sourced from the GRDC Western Region Grownotes for Canola (2015) as an annual application to establish new crops.

These figures do not include any nutrient input from stock manure and urine associated with a grazing system which could not be quantified.

Table 1 indicates total nutrient inputs for individual landuses over a 30-year period, which equates to a single rotation for a Pinus radiata plantation. It assumes annual inputs of fertiliser to the agricultural uses. Table 2 below shows the 30-year cumulative rates for the current practice of 80% pasture paddocks and 20% hay paddocks. It also adds a moderate mixed cropping /grazing mix of 60% pasture, 10% hay and 30% canola.

Table 2: Elemental nutrient inputs from fertiliser for current farming practice, mixed cropping/grazing and pine plantation.

	Establishment (year 1)		Maintenance		Cumulative (30 years)	
Landuse	N kg/ha	P kg/ha	N kg/ha	P kg/ha	N kg/ha	P kg/ha
Pasture (80%) Hay (20%)			10.2	5.3	306	159
Pasture (60%) Hay (10%) Canola (30%)	24	2.1	5.1	3.71	873	174.3
Plantation (100%)	29.7	33.3	192	60	221.7	93.3

Pasture/Hay/Canola figures are based on the annual inputs in Table 1 for Pasture/Hay x 70% and Canola x 30% as annual inputs.

The plantation Management Plan indicates that the fertiliser inputs may not be necessary due to the high nutrient status of the existing pastures, and I believe the proponents are conservative in their estimation of potential nutrient inputs. The plantation establishment fertiliser rates are in line with industry standards, and I believe they will be necessary, particularly the N input, regardless of the nutrient status of the existing pasture. Additional nutrients at establishment allows the seedlings to boost vitality which helps mitigate the impacts of second year weed competition as well as potential insect attacks. Vigorous seedlings can therefore potentially reduce the need for additional herbicides and insecticides.

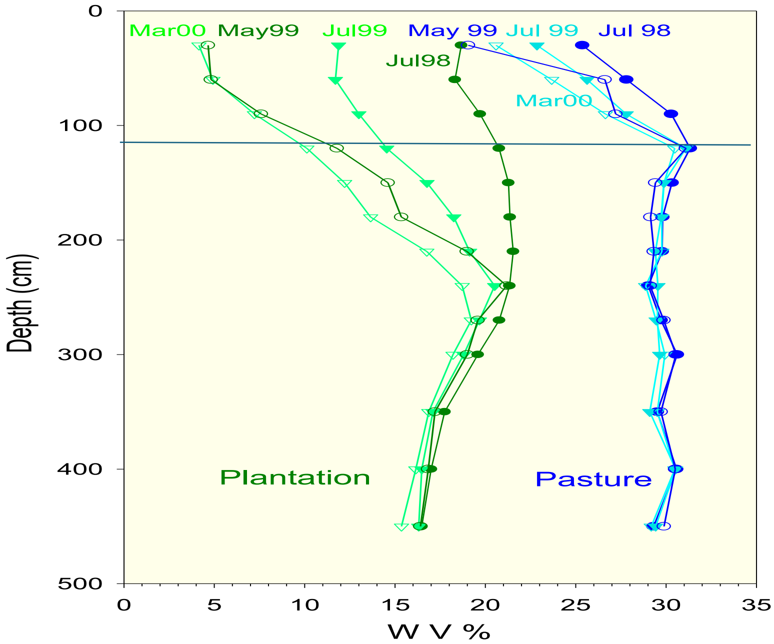
Increased tree growth in response to Nitrogen typically lasts 4 – 5 years in Pinus radiata plantations whereas growth response to adequate phosphorus can last for 10 years or more. While both N and P are phloem mobile enabling the tree to retranslocate these elements from older senescing needles to the new needles on the growing tips branches. However, as the tree increases their biomass further inputs into the system are required. Therefore, even though the soils might have an initial high nutrient status this will be depleted as the trees increase biomass.

The use of Urea fertiliser in the plantation may lead to N losses through volatilisation if not applied under the correct conditions. This would reduce the inputs of N into the soil but cannot be quantified at this point, so it is assumed 100% of the Urea N enters the soil for plant uptake.

The proponents proposed use of soil and foliar nutrient analyses with plantation nutrition decision support tools is a positive step towards only applying what is required and not over-fertilising the area.

Pinus radiata tree roots can extract nutrients and water from several metres depth, much deeper than pasture or hay species or Canola. Therefore there is a reduced risk of nutrient losses to the water table through leaching under a pine plantation than well managed farmland.

Figure 1: Soil moisture contents under pine plantation and pasture over a 2-year period. Duplex sand (to 1.2m) over clay soil, South Stirling Ranges district.



WV% indicates the volume of water in a soil sample
The percentage of moisture (WV%) indicates the volume of water present in a soil sample. It is a crucial measurement for understanding the available water for plants, the risk of soil erosion, and the structural stability of the ground. WV% is often expressed as a percentage of the total volum e of soil, providing a direct measure of the water content within the soil matrix

Figure 1is from research I have conducted in the South Stirlings area, which has a similar climate to the Frankland area. It shows soil water profiles for the wettest and driest months over 2 consecutive years under both a pine plantation and adjacent pasture in a duplex sand over clay soil, similar to the soils on this property. This shows the plantation trees extracting water from 2.5m depth and the soil below that depth remaining at about half the moisture content of the soil under the pasture. Therefore rainfall is being captured and utilised by the plantation, thus preventing leaching to the groundwater, while soils below the pasture remain saturated below 1.2m depth leaving it prone to nutrient leaching (Dumbrell unpublished). Soil water also ponded on the surface of the pasture in the winter months, increasing the risk of offsite surface movement.

The proponents of the pine plantation undertake to maintain and revegetate where necessary, a 30m buffer either side of creek lines and not fertilise 6m either side of identified drainage lines within the plantation. Current farming practices have not provided complete 30m buffers to the creeks allowing the potential for nutrients to be directly applied to water courses, as well as not limiting the potential for surface flow of nutrient laden water or soil into the water courses on the property. The 30m buffers either side of a water course are consistent with Priority 1 and 2 areas within PDWSA's (DWER 2006, DWER 2012).

Environmental Benefits

The proposed pine plantation would have lower inputs of fertiliser over the length of the rotation (30 years) than alternate well managed farming systems. Therefore the risks to excessive nutrient loads to groundwater and surface water streams are reduced. On the Weight of Evidence approach this would be an environmental benefit.

The perennial deep rooted trees will prevent (reduce initially, until established) recharge beneath the planted area. Fertiliser applied to this area will be prevented from reaching the groundwater through both stopping water flow and the extraction of nutrients from depth. On the Weight of Evidence approach when compared to well managed farmland the plantation would provide an environmental benefit.

The pine plantation, through maintenance and revegetation of stream and drainage line buffers, would Improve mitigation measures to prevent the potential of fertiliser being deposited directly into water courses or any overland movement of nutrients into water courses. The current agricultural system does not provide the same level of risk mitigation. Water quality on and leaving the property would therefore likely be improved under a plantation regime through a lower risk of excessive nutrients entering the aquatic systems.

Environmental Disbenefits

No environmental disbenefits identified in relation fertiliser use in the proposed pine plantation.

Chemical Inputs

Herbicides

Herbicides are designed to control pest plants ('weeds') and are useful in many situations for effective eradication. It is important to realise, however, that many herbicides are toxic in aquatic ecosystems. Plants, invertebrates, amphibians and fish may be harmed when herbicide moves into a body of water. Inappropriate use of herbicides may also cause significant risks to human health where water is pumped from a bore for domestic use, or flows to reservoirs. Remember that herbicides can enter waterbodies either directly through spray or spray drift, or they can move into waterbodies via surface water run-off or leaching and sub-surface draining.

Table 3: Herbicide inputs for different relevant landuses.

Landuse	Pre-Plant Broad Spray	Pre-Plant Strip Spray	Post-Plant Spray	Cumulative (30 years)
Pasture				
Hay (pasture)				
Hay (Oats)	1 L/ha Glyphosate[2]			30 L/ha Glyphosate
Canola TT[1]	1.1 kg/ha Atrazine[3]		1.1 kg/ha Atrazine	66 kg/ha Atrazine
			1.0 kg/ha Terbuthylazine	30 kg/ha Terbuthylazine
Plantation	5 L/ha Glyphosate[4]	1.25 L/ha[6] Glyphosate		6.25 l/ha Glyphosate
	15 g/ha[5] Metsulphuron Methyl	5 g/ha[7] Metsulphuron Methyl		20 g/ha Metsulfuron Methyl
			15 L/ha hexazinone	15 L/ha Hexazinone

1. Triazine Tolerant Canola used as it is the dominant type grown in WA.
2. Lowest rate recommended
3. Lowest rate recommended
4. Highest rate proposed
5. Highest rate proposed.
6. Based on a rate of 5 L/ha covering the strips only which are 25% of the area
7. Based on a rate of 20 g/ha covering the strips only which are 25% of the area

The plantation rates were taken from the Plantation Management Plan.
The pasture and hay values were supplied by the land owner as current practice and assumed that the hay was derived from pasture grasses and clover. The application of a low rate of glyphosate to suppress existing pasture species prior to sowing oats is an accepted practice. The existing land owner has not specified what system is used.

Herbicide regimes for Canola were sourced from the Department of Primary Industries and Regional Development (DPIRD) information bulletin (DPIRD 2020) as an annual application.

Table 3 indicates total herbicide inputs for individual landuses over a 30-year period, which equates to a single rotation for a Pinus radiata plantation. It assumes annual inputs of herbicides to the agricultural uses. Table 4 below shows the 30-year cumulative rates for the current practice of pasture and hay. It also adds a grazing mix of 80% pasture and 20% oats hay and a moderate mixed cropping /grazing mix of 60% pasture, 10% hay (pasture) and 30% canola.

Table 4: Herbicide inputs for different relevant landuses.

Landuse	Pre-Plant Broad Spray	Pre-Plant Strip Spray	Post-Plant Spray	Cumulative (30 years)
Pasture/Hay (pasture)				
Pasture/Hay (Oats)	0.2 L/ha Glyphosate[2]			6 L/ha Glyphosate
Pasture/Hay (pasture)/Canola TT[1]	0.33 kg/ha Atrazine[3]		0.33 kg/ha Atrazine	19.8 kg/ha Atrazine
			0.3 kg/ha Terbuthylazine	9 kg/ha Terbuthylazine
Plantation	5 L/ha Glyphosate[4]	1.25 L/ha[6] Glyphosate		6.25 l/ha Glyphosate
	15 g/ha[5] Metsulphuron Methyl	5 g/ha[7] Metsulphuron Methyl		20 g/ha Metsulfuron Methyl
			15 L/ha hexazinone	15 L/ha Hexazinone

The Pasture/Hay (oats) system assumes the area previously used for Hay (pasture) is now oats. Figures in this table are based on 20% of the maximum rates in Table 3 for oat hay as annual inputs.

The Pasture/Hay/Canola system assumes the area previously used for Pasture/Hay (pasture) is now 60% pasture, 10% hay (pasture) and 30% Canola. Figures in this table are based on 30% of the maximum rates in Table 3 for canola as annual inputs.

The nil herbicide input into the current farming practice of Pasture/Hay (80%/20%) utilising pasture species boosted by N inputs to produce the hay, does not account for the possibility of spraying out paddocks and reseeding at some point(s) over the next 30 years, or the need to control declared weed species. Therefore it is probably optimistic to say that nil herbicides will be applied in this system, but it will be assumed for the purpose of this comparison.

Correctly applied, Glyphosate, Hexazinone and Metsulfuron Methyl are all permitted to be used within drinking water catchments in WA (Dept Health 2006). Atrazine and Terbuthylazine are not permitted. Under the FSC guidelines both Atrazine and Glyphosate are classified as Restricted chemicals (lowest rating), with no known aquatic system or mammal acute toxicity impacts. Terbuthylazine, Hexazinine and Metsulfuron Methyl are unrestricted (FSC 2019), again with no known aquatic system or mammal acute toxicity impacts. Therefore the herbicides applied in any of these systems can be considered to have low environmental impact when applied at the rates prescribed and in accordance with the relevant label conditions. All these herbicides are registered for use by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

The plantation herbicide use is generally limited to the first 18 months of the plantation and targeted to the planting strip. The Hexazinone for 2nd year weed control on the planting mound may or may not be used, or only a portion of the plantation may require it, but for the purpose of this comparison it will be assumed to be applied to the total plantation.

As outlined previously, the proponents of the pine plantation have undertaken to maintain and revegetate where necessary, a 30m buffer either side of creek lines. Current farming practices have not provided complete 30m buffers to the creeks allowing the potential for herbicides to be directly applied to water courses, as well as not limiting the potential for surface flow of chemical laden water or soil into the water courses on the property. The 30m buffers either side of a water course are consistent with Priority 1 and 2 areas within PDWSA's (DWER 2006).

Environmental Benefits

The pine plantation, through maintenance and revegetation of stream and drainage line buffers, would Improve mitigation measures to prevent the potential of herbicides being deposited directly into water courses or any overland movement of chemicals into water courses. The current agricultural system does not provide the same level of risk mitigation. Water quality on and leaving the property would therefore likely be improved under a plantation regime through a lower risk of chemicals entering the aquatic systems.

The application of herbicides once every 30 years in pine plantations does not contribute to the development of herbicide resistance in target species, which is becoming increasingly problematic in well managed farming systems. Herbicide resistance would necessitate alternate or new potentially more toxic chemicals being introduced into the farming system to overcome the resistance issues and maintain farm productivity.

When canola is introduced into the farming system (at 30%), the input of herbicides under a pine plantation regime are slightly better in terms of totals applied and the types of herbicides used. Therefore the reduced input of chemical loads would reduce the risk of groundwater and surface water contamination. On the Weight of Evidence approach this would be an environmental benefit.

Environmental Disbenefits

The herbicide inputs in the proposed pine plantation are greater than the inputs in the current Pasture/Hay system utilising pasture species boosted by N inputs to produce the hay, although their likely impact on the environment is low. The herbicides used in the establishment of the pine plantation are not known to cause acute toxicity in mammals or the aquatic environment, and are all approved for use in Public Drinking Water Source Areas. The disbenefit is minor and is based on the assumption that there will be no herbicide applied to the pasture/hay system over the corresponding 30 years of the plantation. With this in mind on balance the Environmental Benefits marginally outweigh the Disbenefits.

Insecticides, Miticides

Insecticides have a significant impact on aquatic systems, leading to various negative effects on aquatic life and water quality. The application of insecticides can cause dissolved oxygen depletion, contamination of water bodies, and harm to the aquatic food chain. These chemicals can disrupt the balance of the ecosystem, affecting the quality of water, biodiversity, and the abundance of aquatic species. The toxicity of insecticides poses a threat to the liver, kidneys, gills, a nd nervous system of fish, which are primary targets of their toxic effects. Therefore, it is beneficial to reduce the risk of pesticides entering by reducing the amounts used and the types used.

Table 5: Insecticide and Miticide inputs for different relevant landuses.

Landuse	Mites	Sap Suckers (eg. Aphids)	Leaf Chewers (eg. Budworm, Rutherglen bug, spring beetles)	Cumulative (30 years)
Pasture/ Hay	Bifenthrin (a.i.)10 g/ha Omethate (a.i.) 29 g/ha			Bifenthrin 300 g/ha Omethate 870 g/ha
Canola TT[1]	Imidacloprid or Fipronil (as seed dressings) plus Bifenthrin (a.i.)10 g/ha Omethate (a.i.) 29 g/ha as broadspray	Primicarb 250g/ha (a.i) Or Sulfoxaflor 24 g/ha (a.i.)	Gamma-Cyhalothrin 3 g/ha (ai) Or Alpha-cypermethrin 20 ml/ha (ai)	Primicarb 825g/ha (a.i) Alpha-cypermethrin 66 ml/ha Bifenthrin 100 g/ha Omethate 261 g/ha
Plantation			Alpha-cypermethrin 16 ml/ha (ai)	Alpha-cypermethrin 16 ml/ha

Cumulative total is based on one application per season.
Mite control in Pasture/Hay system is based on advice from current land manager.
Canola cumulative Sap sucking and leaf chewing control based on Canola at 30% landuse with applications at the lowest rate once every 3 seasons. Of the two synthetic pyrethroids, Alpha-Cypermethrin was used as a direct comparison with Plantation use.
The concentration of either imidacloprid or fipronil in seed coatings could not be determined or the number of seed per ha, therefore the input of these pesticides could not be determined.

Invertebrate pasture pests include redlegged earth mite, blue oat mite, heliothis caterpillars, black headed cockchafers, diamondback moth, aphids and lucerne flea, all of which affect Canola as well. Targeting only mites helps protect beneficial insects that may be present as well. Therefore while other insect control on pastures may occur it has not been included in this assessment.

Numerous insect species can infest canola crops, but the application of a chemical insecticide is not always necessary. However because Canola is established from direct sown seed this crop when compared to pine trees is much more vulnerable to pests and diseases because of the different life cycle stages it goes through in the field. Therefore a variety of control measures may be necessary in any one growing season. For example, infestations of turnip aphids, cabbage aphids, and green peach aphids can reach damaging levels in canola crops in WA. Aphid specific control measures in canola promote the use of Primicarb (Carbamate chemical) which is on the FSC prohibited list (FSC 2019) because of its acute toxicity to mammals, a carcinogen and aquatic toxicity.

Pine seedlings are one year old when they are planted into the field. Initial pest and disease control is managed in the nursery thus negating the need for chemical treatments in the field for this most vulnerable period. It is usually only the leaf chewing insects that emerge in Spring that are of a concern to pine plantations. Typical growth rates for P. radiata in WA are 2m in the first year and 1m per year thereafter. Therefore, controlling insects in the first Spring after planting is crucial but thereafter is generally not required due to their size and the less palatable nature of the older trees.

Annual applications of pesticides to control insects and mites is leading to resistance in target species in the same way weeds are becoming resistant to herbicides. Western Australia is the only state to have Red Legged Earth Mite (RLEM) that are resistant to the synthetic pyrethroid (SP) insecticides. Resistant RLEM populations are likely to be present in more localities in Western Australia and elsewhere in southern Australia, especially in paddocks that have a history of repeated SP applications. WA now has a confirmed RLEM population resistant to the Organophosphate (OP) omethoate. Green Peach Aphid a major pest of Canola and other crops has developed resistance to both SP and OP pesticides as well as the Carbamate group (GRDC 2015).

All these pesticides are registered for use in WA by the APVMA. All the listed pesticides except Sulfloxaflor are known to be acutely toxic to mammals and aquatic systems.

Environmental Benefits

The pine plantation, through maintenance and revegetation of stream and drainage line buffers, would Improve mitigation measures to prevent the potential of pesticides being deposited directly into water courses or any overland movement of chemicals into water courses. The current agricultural system does not provide the same level of risk mitigation. Water quality on and leaving the property would therefore likely be improved under a plantation regime through a lower risk of chemicals entering the aquatic systems.

The application of insecticides once every 30 years in pine plantations does not contribute to the development of herbicide resistance in target species, which is becoming increasingly problematic in well managed farming systems. Pesticide resistance can potentially lead to alternate or new more toxic chemicals being introduced into the farming system to overcome the resistance issues and maintain farm productivity.

The proposed pine plantation would have lower inputs of pesticides over the length of the rotation (30 years) than alternate well managed farming systems. Therefore, the risks to chemical contamination of groundwater and surface water streams are reduced. On the Weight of Evidence approach this would be an environmental benefit.

Environmental Disbenefits

No environmental disbenefits identified in relation insecticide use in the proposed pine plantation.

Fungicides

Blackleg is the most important disease of canola. Use of fungicide seed dressings containing fluquinconazole or fertiliser treated with flutriafol will assist in minimising the effects of blackleg and protect seedlings from early infection, which later causes stem canker development (GRDC 2015).

Sclerotinia stem rot is caused by the fungus Sclerotinia sclerotiorum is another important disease of canola. Broadscale foliar applications of either Iprodione, Procymidone, or Prothioconazole + tebuconazole can control the disease (GRDC 2015).

Fungicide treatments to control diseases in newly emerged pine seedlings is conducted in the nursery. No fungicide applications are required after planting out in the field.

Environmental Benefits

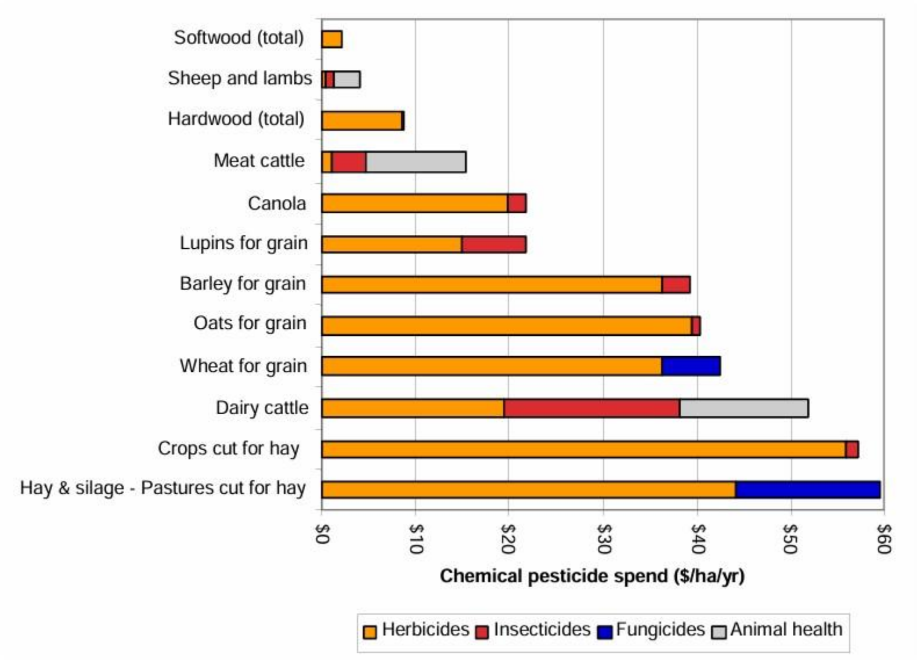
While the inputs of fungicide in well managed farming systems hasn't been quantified the fact that no fungicides are applied in the field to pine plantations means there is an environmental benefit to this system.

Environmental Disbenefits

No environmental disbenefits identified in relation fungicide use in the proposed pine plantation.

Further Information

This assessment has been based on the Plantation Management Plan as provided by the proponents, the farm management practices of the current land owner and a best prediction of a mixed farming system relevant to the region. Jenkins and Tompkins (2006) conducted a comprehensive study into the chemical pesticide use in Australian plantation forests. This study surveyed forest managers across the country and purchased information relating to agricultural chemical use. The study divided the country into 6 regions. Below is the results from the Western Region which takes in the lower half of Western Australia. It is a more comprehensive assessment of the various farming and plantation systems and presented in $/ha/yr terms rather than actual chemical inputs. This does still provide a valid relative comparison. P. radiata is classified as a softwood. This study appears to support my assessment presented above.



Summary

Without background information on the nutrient status, and pesticide concentrations and trends in the soil and water resources on the property the current environmental status can not be determined. Therefore, applying a weight-of-evidence process (ANZG 2018) incorporating judgements about the quality, quantity, relevance and congruence of the data contained in the plantation management plan and known current and potential farming practices, the Environmental Benefits identified favour the establishment of a pine plantation.

The data considered related to;

1. System inputs – The type and rate of fertiliser and pesticides applied in the different systems
2. System outputs – Chemical pathways; leaching potential, surface movement, and
3. Mitigation measures – buffer zone size and placement.

There are three key areas where on Weight of Evidence the proposed plantation will provide environmental benefits over well managed farmland on the proposed site.

1. The proposed pine plantation would have lower inputs of fertiliser and chemicals over the length of the rotation (30 years) than alternate well managed farming systems. Therefore the risks to excessive nutrient loads to, and contamination of, groundwater and surface water streams are reduced. On Weight of Evidence approach this would be an environmental benefit.
2. The pine plantation, through maintenance and revegetation of stream and drainage line buffers, would Improve mitigation measures to prevent the potential of pesticides being deposited directly into water courses or any overland movement of chemicals into water courses. The current agricultural system does not provide the same level of risk mitigation. Water quality on and leaving the property would therefore likely be improved under a plantation regime through a lower risk of chemicals entering the aquatic systems.

3. The establishment of a pine plantation would break the frequent applications of chemicals that lead to weed and pest resistance that threaten both the environment and farm productivity. Pesticide resistance necessitates alternate or new potentially more toxic chemicals being introduced into the farming system to overcome the resistance issues to maintain farm productivity.

References

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Department of Health (2006). Use of herbicides in water catchment areas. Circular N0: PSC88. August 2006.

DPIRD (2024), Canola – essentials for growing a successful crop. Department of Primary Industries and Regional Development, Western Australia, Perth. Article DPIRD-34.

DPIRD (2020). Chemical weed control in canola. Bulletin No 4907. Department of Primary Industries and Regional Development, Western Australia, Perth. August 2020.

DWER (2006). *Vegetation buffers to sensitive water resources*. Water Quality Protection Note 6. Department of Water and Environmental Regulation. February 2006.

DWER (2021). *Land use compatibility tables for public drinking water source areas*. Water Quality Protection Note 25. Department of Water and Environmental Regulation. April 2021.

DWER (2012). *Plantations in public drinking water source areas*. Water Quality Protection Note 121. Department of Water and Environmental Regulation. November 2012.

Forest Stewardship Council (2019). FSC Lists of highly hazardous pesticides FSC-POL-30-001a EN, FSC Bonn Germany. May 2019.

GRDC (2015). Canola Western Region. Grains Research and Development Corporation Grownote. August 2015.

Jenkins, B. and Tomkins, B. (2006). *The use of chemical pesticides by the Australian plantation forest industry*. Forest and Wood Products Research Development Corporation Report: Project No PN06.4016. September 2006.

USEPA (2015). Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria. United States Environmental Protection Agency - Office of Water EPA - 820-S-15-001. February 2015.

IAN DUMBRELL

CURRICULUM VITAE

Mr Dumbrell has a Bachelors Degree in Environmental Science with Honours in Biology from Murdoch University.

He has had 12 years' experience as an operational forester and 35 subsequent years' experience in forest research. He has worked in both Government and Private Forestry organistions focussing on ecophysiological and silviculture research in hardwood and softwood plantation species in southern Western Australia. The ecophysiological research has been predominately related to fertiliser application to enhance tree growth, the effects of climate and water availability on tree growth, and plantation water use as it affects the local environment. He also has two decades of experience in silvicultural influences on wood properties as well as weed and pest management in plantations.

Mr Dumbrell is a trained internal environmental auditor. He led the compliance and audit branch of the WA State Governments Forestry Commission with 5 years experience in this area.

Mr Dumbrell was the Principal Research Scientist for the Industry Plantation Management Group (IPMG) from 2018-2021 during which he directly collaborated with industry partners to establish and manage a range of research projects both locally and nationally. He has chaired several national research project steering committees and holds a Diploma in Management and a Diploma in Project Management. He is currently self-employed, actively collaborating on two major national plantation silviculture research projects.

QUALIFICATIONS

1976 -1977	Certificate in Forestry Field Work. Mount Lawley College of Technical and Further Education
1982-1992	Bachelor of Science in Environmental Science, Murdoch University, Western Australia.
1993-1994	Honours Degree in Biological Sciences, Murdoch University. Honours thesis: 'The effects of fertilisation and/or thinning on wood density of *Pinus radiata* in the SW of WA'.
2001-2002	Diploma of Management, Challenger College of Technical and Further Education.
2012	Diploma of Project Management. Central Institute of Technology, Perth.

.

CAREER PROGRESSION

1978 - 1980	Forest Ranger with the Forests Dept of WA, Walpole and Pemberton. General operations field work with specific emphasis on hardwood logging, and minor forest produce regulation.
1980 - 1984	Ore Heavy Equipment Operator, Wickham WA. Worked in all areas of the iron ore processing plant with experience in running both the train unloading control room and the main plant control room.
1984 - 1988	Forest Ranger with the Dept of Conservation and Land Management (CALM), Pemberton and Collie. **Softwood Plantation Management;** Management plan preparation, site preparation, planting, tending and harvesting; **Nature Reserve Management;** Compilation of interim management plans and protection of reserves. **Recreation;** Maintenance and upgrade of recreation sites, extensive liaising with school groups, sporting and special interest groups. **Roading;** Maintenance, upgrade and construction of all roads within the district boundary.
1988-1996	Forester (technical) Science and Information Division, CALM - Busselton. Technical officer specialising in plantation nutrition and water use. Provided technical support in the plantation silviculture, agroforestry, and tree breeding programs.
1996 -2003	CALM Science Division Busselton Research Centre Manager responsible for the research centre budget, administration, and four staff. Senior Research Scientist – plantation silviculture.
2003 - 2010	Silviculture Senior Research Scientist with the Forest Products Commission (FPC) - plantation silviculture, specifically thinning, tree nutrition and tree water use.
2010 – 2013	Manager Forest Science and Industry Development branch with the FPC, Western Australia, managing a team of 17 research scientists and technical officers.
2013 – 2016	FPC Principal Research Scientist Forest Health. Responsible for plantation nutrition and developing a forest health surveillance system.

2016 – 2018 FPC Manager Compliance and Environmental Certification. Responsible for maintaining FPC's environmental accreditation to ISO 14001 and the Australian Forestry Standard.

2018 – 2021 Principal Research Scientist Industry Plantation Management Group. Conducting forest pest surveys, plantation silviculture research, and pesticide screening trials for a consortium or private and Government forestry companies.

2021 - Private consultancy – Forest Plantation Research. Currently managing a national project funded by Forest and Wood Products Australia (FWPA) *Transforming future softwood productivity through optimal site-specific silviculture*, and have a research role in a second national FWPA project *Enhancing the Knowledge Base for Hardwood Plantation Management*.

PRIOR COMMITTEES AND WORKING GROUPS

State representative National RD&E Forum for Forest and Forest Products representing Governments under the national RD&E Primary Industries strategy.

State representative Sub-committee National Plantation Health and Biosecurity

Research representative National Plantation Industry Pesticide Research Consortium.

WA state representative National Research Working Group 5 – Plantation Silviculture (including past chairman).

WA representative National Research Working Group 7 – Forest Health.

Member, Industry Pest Management Group.

Representative on the south-west "Trees and Water" working group (National Water Initiative)

Steering committee member for the national *Essigella* biocontrol project.

Member blackberry rust biocontrol program working group.

Member, Western Australian Agroforestry Working Group.

Member, Australian Water Association Biosolids Special Interest Group.

SELECT PUBLICATIONS

2025 Smethurst, P., McGrath, J., **Dumbrell, I**., Wiseman, D., May, B., Baker, T. and Mendham, D. (2025) Modelling Nitrogen Fertilisation Responses in Temperate *Eucalyptus* Plantations Using APSIM. *Forest Ecology and Management*. Accepted September 2025.

2024 McGrath, J., **Dumbrell, I**. and May, B. (2024). A tool to predict fertiliser response & profitability in softwood plantations across Australia. Forest and Wood Products Australia report, Project No: VNC476-1819. March, 2024.

McGrath, J., May, B., Smethurst, P., **Dumbrell, I**. and Wiseman, D. (2024) Optimising nutrition management of hardwood plantations for sustainability and profitability. Forest and Wood Products Australia report, Project No: PNC478-1819. February, 2024.

2010 Glen E. Murphy, Mauricio A. Acuna and **Ian Dumbrell** (2010) Tree value and log product yield determination in Radiata pine plantations in Australia: Comparison of terrestrial laser scanning with a forest inventory system and manual measurements. *Canadian Journal of Forest Research,* **40** 2223 – 2233.

2009 Simioni G, Ritson P, Kirschbaum MUF, McGrath J, **Dumbrell I** and Copeland B (2009). The carbon budget of *Pinus radiata* plantations in south-western Australia under four climate change scenarios. *Tree Physiology*, **29** (9) 1081-1093.

Philip Blakemore, Dave Cown, **Ian Dumbrell**, Russell McKinley, Andrew Lyon, Brad Barr and Richard Northway (2009). Western Australian Softwood Resource Evaluation: a survey of key characteristics of the *Pinus radiata* and *Pinus pinaster* resources in Western Australia with links to product performance of trees sampled from each resource, as determined by a processing study. Forest and Wood Products Australia report, Project No: **PNC059.** December, 2009.

2008 Simioni G, Ritson P, McGrath J, Kirschbaum MUF, Copeland B, **Dumbrell I** (2008) Predicting wood production and net ecosystem carbon exchange of *Pinus radiata* plantations in south-western Australia: Application of a process-based model. *Forest Ecology and Management*, **255**, 901-912.

2006 Pritchard, D., Penney, N. and **Dumbrell, I**. (2006) Biosolids: black gold in Western Australia. In proceedings, New Zealand Land Treatment Collective's 27th conference. March 14th to 17th at Nelson, New Zealand.

Dumbrell, I. (2006) Biosolids produce significant long-term growth increases in Western Australian pine plantations without adverse impacts. In proceedings, New Zealand Land Treatment Collective's 27th conference. March 14th to 17th at Nelson, New Zealand.

2005 **Dumbrell**, I. C., McGrath, J. F. and Harper, R. J. (2005) Plantation and farm forestry productivity and water use in Mediterranean environments: a review from south-western Australia. *Australian Timber Review* (In Press).

2004 **Dumbrell**, I.C. (2004) Biosolids application for plantation establishment - a matter of life and death. In: Paper presentations: Biosolids Specialty Conference II, Sydney June 2-4 2004. Australian Water Association, Artarmon, N.S.W.

2003 **Dumbrell**, I.C. and McGrath, J.F. (2003). Growth and nutrient relationships of juvenile *Pinus pinaster* on ex-farmland in Western Australia. *Australian Forestry*, 66 (2), 137-144.

Dumbrell, I.C. and McGrath, J.F. Plantation water use prevents contamination of groundwater following application of biosolids. Poster presentations "Innovations in water" Ozwater 2003 convention and exhibition, Perth 6-10 April 2003. Australian Water Association.

Dumbrell, I.C. and McGrath, J.F. (2003). Phosphorus requirements of young *Pinus pinaster*. In proceedings: 2nd International Symposium of Phosphorus Dynamics in the Soil-Plant Continuum. Perth, Western Australia, 21-26 Sept. 2003.

McGrath, J.F., **Dumbrell,** I.C. Hingston, R.A. and Copeland, B. (2003). Nitrogen and phosphorus increase growth of thinned late rotation *Pinus radiata* on coastal sands in Western Australia. *Australian Forestry*, 66 (3), 217-222.

McGrath, J.F., Copeland, B. and **Dumbrell,** I.C. (2003). Duration and magnitude of growth and wood quality responses to phosphorus and nitrogen by thinned *Pinus radiata* in southern Western Australia. *Australian Forestry*, 66 (3), 223-230.

Penney, N., **Dumbrell**, I.C. and Pritchard, D. (2003). Biosolids in Western Australia – Wanted not Wasted. In proceedings – ORBIT 2003: Biological processing of organics: Advances for a sustainable society. Fourth international conference of the ORBIT association. Perth, May 2003.

Ritson, P., **Dumbrell**, I.C., Brand, B.M., McGrath, J.F., Copeland, B., Allen, D. and Mann, S. (2003). Biomass partitioning to fine and coarse roots and above-ground biomass of *Pinus radiata* trees in response to nitrogen fertilisation. Accepted for special edition of Tree Physiology – "Dynamics of Physiological Processes in Woody Roots".

Dumbrell, I.C., McGrath, J.F. and Dell, B. The influence of thinning and fertilisation on wood density of *Pinus radiata* in southern Western Australia.

Dumbrell, I.C., Copeland, B., McGrath, J.F. and Mungham, K. Growth responses to rates of nitrogen and timing of application by mid- rotation *Pinus radiata* growing in southern Western Australia.

McGrath J. F., Read B., **Dumbrell** I. C. Impact of early thinning and fertilisation of *Pinus radiata* in a Mediterranean climate on growth seasonal growth patterns and partitioning of the growth within the stand.

McGrath J. F., **Dumbrell** I. C., Read B. and Mungham K. J. Impact of early thinning and fertilisation of *Pinus radiata* in a Mediterranean climate on site and tree water status.

McGrath J. F., Crombie D. S., **Dumbrell** I. C. Mungham K. J. and Read B. Comparative water use and water relations of *Pinus radiata* and *Pinus pinaster* in a Mediterranean climate.

McGrath J. F., **Dumbrell** I. C. and Mungham K. J. Impact of site fertility and water supply on seasonal growth patterns the response to fertilisation by *Eucalyptus globulus* in south-western Australia.

2002 **Dumbrell**, I.C. and McGrath, J.F. (2002). Biosolids produce significant increases in growth and nutrient status in a Western Australian pine plantation without contamination of groundwater. In: Paper presentations: Biosolids Specialty Conference, Sydney June 19-20 2002. Australian Water Association, Artarmon, N.S.W. pp1-8.

Dumbrell, I.C., McGrath, J.F. and Fremlin, R.R.A. (2002). Impacts of broadscale weed control and fertilisation at establishment on survival and growth of second rotation pines. In: Paper presentations: 13th Australian Weeds Conference, Perth Sept 8-13 2002. Plant Protection Society of WA.

Dumbrell, I.C. and McGrath, J.F. (2002) Productivity and water use of maritime pine in southwest Western Australia. Unpublished report for the Forests Products Commission Board, Western Australia.

Dumbrell, I.C. (2002) Application of biosolids to pine plantations of the Swan Coastal Plain. Unpublished report for the Water Corporation of Western Australia. pp. 1-30.

2000 **Dumbrell**, I.C. and McGrath, J.F. (2000). Soil water depletion by *Pinus*

pinaster plantations in the 400 mm to 600 mm rainfall zone of Western

Australia. In Soil 2000: new horizons for a new century: Australian and New Zealand second joint soils conference. Volume 3, poster papers New Zealand Society of Soil Science, Canterbury. pp. 59-60.

1999 **Dumbrell**, I.C. (1999). Form disorders of maritime pine (Pinus pinaster) growing on ex-pasture sites in Western Australia. Department of Conservation and Land Management, Western Australia, pp. 1-9.

1994 **Dumbrell**, I.C. (1994). The effects of thinning and fertilisation on wood density in Pinus radiata growing in the south west of Western Australia. Thesis Biological Science (Hons)- Murdoch University. pp. 1-136.

SELECT PRESENTATIONS

2010 "Pinus pinaster in Western Australia". Oral presentation to Forestry Faculty Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade Técnica de Lisboa, Lisbon, Portugal. April 2010.

2006 "Current challenges in plantation weed control in Western Australia". Oral presentation – 4th biennial Plantation Pest Control workshop. 28th Feb – 1st March 2006, Mt Gambier, South Australia.

Biosolids produce significant long-term growth increases in Western Australian pine plantations without adverse impacts. Poster presentation, New Zealand Land Treatment Collective's 27th conference. March 14th to 17th at Nelson, New Zealand.

2005 Productivity and water use of *Pinus pinaster* in South-west Western Australia". Presentation to Tsukuba and Seikei Universities (Japan) delegation, Perth, WA Feb 2005.

"Plantation nutrition and water use in South-west Western Australia". Presentation to Fujian Forestry (China) delegation. Collie, WA March 2005.

“Tree water use – Methods and current research in South-West WA”. “Trees, Water and Salt” workshop. Collie WA, Aug 23-25 2005.

2004 “Tree plantations and water use issues”. Forestry Tasmania seminar, Hobart, April 2004.

“Biosolids application for plantation establishment - a matter of life and death”. Biosolids Specialty Conference, June 2004, Sydney.

“Biosolids sustain growth in pine plantations”. Biosolids Specialty Conference, June 2004, Sydney.

2003 “Plantation water use prevents contamination of groundwater following application of biosolids.” Australian Water Association Ozwater 2003 conference, April 2003, Perth.

“Phosphorus requirements of young *Pinus pinaster*.” Phosphorus Dynamics in the Soil-Plant Continuum 2nd International Symposium, September 2003, Perth.

2002 “Biosolids produce significant increases in growth and nutrient status in Western Australian pine plantations without contamination of groundwater.” Biosolids Specialty Conference, June 2002, Sydney.

“Impacts of broadscale weed control and fertilisation at establishment on survival and growth of second rotation pines.” 13th Australian Weeds Conference, September 2002, Perth.

2000 “Soil water depletion by *Pinus pinaster* plantations in the 400mm to 600mm rainfall zone of Western Australia.” Joint New Zealand Soil Science Society/Australian Soil Science Society, Soils 2000 Conference. Christchurch, New Zealand, Dec 2000.