

MEMO

Date: 12/10/2022
To: Kingshill Development No 1 Pty Ltd and Kingshill
Development No 2 Pty Ltd
From: Mark Aitkens
Pages: 8 inc. this page
Regarding: PR130430 Kings Hill: Tree Canopy Nutrient Enrichment

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Amendment of Tree Canopy Nutrient Enrichment program (i.e. increase available nitrogen) for the koala (*Phascolarctos cinereus*) at Kings Hill, NSW

This memo describes amendments to the proposed Tree Canopy Nutrient Enrichment program in response to concerns raised during the regulators assessment of the Project.

Statement regarding Expert Witness Code of Conduct

I have been provided with Division 2 of Part 31 of the Uniform Civil Procedure Rules 2005 and the Expert Witness Code of Conduct contained within Schedule 7 of those Rules. I have read these documents and agree to be bound by them in the preparation of this report.

My opinions expressed in this report are my own. I have made relevant enquiries I believe to be desirable or relevant. To the best of my knowledge, there is no material or relevant information which I have not considered. Further, I have not withheld my opinion in respect of any matters relevant to the subject matter of this report.

Background

1. The Kings Hill Concept Development Application (Kings Hill project) involves a suite of environmental management and mitigation measures designed to address direct and indirect impacts on threatened species and the environment. The koala (*Phascolarctos cinereus*) occupies habitat affected by the Kings Hill project where the proposed habitat loss through sequential clearing over an estimated 18 year period is combined with habitat protection and management on lands adjacent to the impact.
2. One of the mitigation measures proposed is a Tree Canopy Nutrient Enrichment program where the objective is to increase available nitrogen in the tree canopy at the landscape scale. This program is to be implemented within a proposed Conservation Area and involves, in part, the use of silvicultural practices (i.e. thinning) to aid in the implementation of the program.
3. Assessment by the NSW Regional Planning Panel, involving a peer review by Umwelt and advice from the Department of Planning and Environment, has raised concerns as to the use of tree thinning practices as part of the enrichment program. The concerns relate to the impact of tree removal within an area of koala habitat.
4. These concerns are not supported by the literature. Retention forestry (i.e. saw log removal from harvest and exclusion areas) involves the use of silvicultural practices such as thinning. Kavanagh et al (2007) and Law et al (2022) show that koala activity and densities do not reduce as predicted within an area subject to silvicultural practices.

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Rationale for Enrichment

1. Adequate nutrition is a fundamental requirement for the maintenance and growth of wild marsupial folivores in nutrient poor Australian eucalypt forests where such fauna tend to aggregate in communities with high foliar nutrient concentrations (Braithwaite et al 1984) or high productivity (Youngentob et al 2015). However, the diet of forest marsupial folivores is complex involving browse selection that adequately meets nutritional need (i.e. available nitrogen) while avoiding the effects of inhibitory toxic plant defensive mechanisms [i.e. tannins or plant secondary metabolites (PSMs)] (Moore et al 2010; Wallis et al 2012). The importance of available nitrogen in the diet of a forest omnivore is evident in the brushtail possum (*Trichosurus vulpecula*) where elevated nitrogen availability increases the reproductive success and growth rates of this species (DeGabriel et al 2009). Notably, the brush-tailed possum has a similar foliar browse selection to that of the koala (*Phascolarctos cinereus*) (Moore and Foley 2005; Marsh et al 2014).
2. The density of Australian forest herbivore populations varies and is related to browse nutritional quality at the local and landscape scale (Moore et al 2010). This is particularly the case for low density koala populations where diet choice in habitats of low nutritional quality requires trade-offs between browse nutrients, toxins, the energy cost of movement (Stalenberg et al 2014) and reproductive success (DeGabriel et al 2009; McArt et al. 2009). Such effects have a direct effect on the carrying capacity of a system (Au et al 2019).
3. Several studies indicate that the koala adopts a foraging strategy prioritises nutrition at the lowest cost, thereby maximising net energy gain. In a 10 year study, Moore and Foley (2005) show that plant chemistry (i.e. low concentrations of nitrogen and/ or high concentrations of PSMs) restrict tree use by this folivore with these limitations effecting the regulation of food availability and populations. This is consistent with Marsh et al (2014) where browse decisions made by wild koalas depends on tree palatability, with koalas found to spend more time in palatable trees where longer meals are observed.
4. Nutritional mechanisms underpinning folivore occurrence in a forest vary as there are differences in browse quality both within and between tree species making this a critical and overlooked factor in determining habitat quality. Disturbance at the forest stand scale such as forestry leads to compositional change in tree canopy species that can meaningfully alter habitat quality through nutritional shifts that can adversely affect carrying capacity (Au et al 2019). Tree compositional change that favours a dominance of unpalatable browse species is likely to lead to inadequate nutritional value at the forest stand scale reducing habitat occupancy (Au et al 2019). Such forest manipulations are generally for silviculture purposes, not wildlife conservation, and lack an evidence-based consideration for affected herbivores.
5. In a selectively logged forest, Kavanagh et al (2007) found no adverse impact on koala populations following the retention of nutritious koala browse species at the expense of unpalatable trees (i.e. harvesting of *Callitrus glaucophylla*). Unpublished koala radio tracking observations in a logged mid-north coast forest recently showed unexpected use of eucalypt regrowth in regenerating logged patches where adjacent mature remnant trees in riparian zones are retained (<https://www.abc.net.au/news/2019-02-09/gps-tracking-technology-used-to-help-serve-koalas/10789202>).
6. These observations are not inconsistent with Kavanagh and Stanton (2012), which found significant koala utilisation in four to seven year old eucalypt plantations, with koala occupancy of these young eucalypt plantations strongly influenced by proximity to remnant vegetation. Such insights lend support to forest manipulations that aim to enhance arboreal folivore carrying capacity by proportionally increasing the local abundance of nutritious trees. Accordingly, the application of common silviculture practices such as tending, thinning, direct seeding and plantings that increase localised abundance of palatable koala trees are likely to synthesise benefit observed at the forest stand scale (Kavanagh and Stanton 2012).

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The Tree Canopy Nutrient Enrichment Program as Proposed in the Species Impact Statement (SIS)

7. The Kings Hill project proposes several management practices as part of a broad initiative to establish the long-term management of native vegetation and habitat for locally occurring threatened species such as the koala. For the koala, this includes a 'tree canopy nutrient enrichment' program to increase available nitrogen at the forest stand scale as described in Section 7.1.1.2 of the Species Impact Statement (SIS) prepared for the project (Tab 15, p2018-2022). Three enrichment treatments are proposed and described in Table 7.7 of the SIS (Tab 15, p2019), which is reproduced below for ease of reference.

Table 7.7 Tree Canopy Nutrient Enrichment: Treatments, Purpose and Time to Ecological Benefit

Enrichment Treatment	Purpose	Time to Ecological Benefit
'Tending' of insitu recruiting preferred Koala feed tree species in areas of low digestible nitrogen using stand thinning (gap creation) and selective removal of recruiting tree species with low digestible nitrogen values	• Enrich habitat suitability for canopy folivores • Locally increase fallen log length from thinned tree species • Minimise disruption to existing ecological function	7+ years (Kavanagh and Stanton 2012)
Direct seeding using propagules with known high digestible nitrogen combined with mosaic fire burns to accelerate natural regeneration	• Enrich habitat suitability for canopy folivores with minimal impact on stem densities • Minimise disruption to existing ecological function	Unknown but estimated to be at least 7+ years (Kavanagh and Stanton 2012)
Intra forest tree plantings using forestry tubes propagated from trees with known high digestible nitrogen and low PSMs in areas with low predicted digestible nitrogen and/ or weed management areas	• Hasten forest structure regeneration following weed management • Enrich habitat suitability for canopy folivores with high value digestible nitrogen propagules	Unknown but estimated to be at least 7+ years (Kavanagh and Stanton 2012)

8. The following describes each of the proposed treatments in the forest enrichment program.

Tending

Tending is the term applied to pre-harvest silvicultural treatment of forest crop trees at any stage after initial planting or seeding. The treatment can be of the crop itself (e.g., spacing, pruning, thinning, and improvement cutting) or of competing vegetation (e.g., weeding, cleaning) (International Union of Forestry Research Organisations 1971).

The forest vegetation at Kings Hill is an unmanaged system comprising a mature tree canopy and various younger tree cohorts of varying species type, occurrence and density. The use of tending in the forest of the Conservation Area at Kings Hill would involve the following steps:

- Mapping of regenerating koala feed trees in areas that may benefit from forest enrichment works.
- Identification of suitable tending practices for regenerating koala feed trees in this zone; and
- Implementation of suitable tending practices.

This management practice serves to hasten the growth of tree species that would be used by the koala for browsing purposes. It is a forest manipulation practice that has been applied in many circumstances and is recognised as a suitable technique for the delivery of desired forestry outcomes.

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At Kings Hill, the desired outcome is to encourage the growth of preferred koala feed trees including Tallowwood; being a widely cultivated and desired sawlog species in active NSW forestry areas.

Direct seeding

Involves sowing seed directly into prepared ground. Seed would be obtained locally.

Intra forest tree plantings

In forestry this is known as enrichment planting (Keefe et al 2012) and is a strategy for enhancing natural forests' economic value is to increase their concentration of economically important, indigenous tree species by planting seeds or seedlings for future harvest. Such practices often involve tree thinning to increase the availability.

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Amendments to the Tree Canopy Nutrient Enrichment Program

9. The amended Tree Canopy Nutrient Enrichment Program is described in the following table with the amended enrichment management area shown in Figure 1.

Enrichment Treatment SIS Specification	Amended Specification	Change	Predicted Effort
'Tending' of insitu recruiting preferred Koala feed tree species in areas of low digestible nitrogen using stand thinning (gap creation) and selective removal of recruiting tree species with low digestible nitrogen values	'Tending' of insitu recruiting preferred Koala feed tree species in areas of low digestible nitrogen using stand thinning (gap creation) and selective removal of recruiting tree species with low digestible nitrogen values using intense weed management, fire management and tree protection measures	Removal of tree thinning Increase in weed management, fire management and tree protection works	400-600 trees in a 'combined' management area ('enrichment only' and 'weed' management areas shown in Figure 1) are estimated to be actively managed in this manner.
Direct seeding using propagules with known high digestible nitrogen combined with mosaic fire burns to accelerate natural regeneration	Direct seeding using propagules from local trees with known high digestible nitrogen and low PSMs combined with mosaic fire burns and intense weed management to accelerate natural regeneration	Increase in weed management	Supplementary to planting efforts in 'weed' management area shown in Figure 1 (149.7 ha). True beneficial effect unknown.
Intra forest tree plantings using forestry tubes propagated from trees with known high digestible nitrogen and low PSMs in areas with low predicted digestible nitrogen and/ or weed management areas	Intra forest tree plantings using forestry tubes propagated from local trees with known high digestible nitrogen and low PSMs in areas with low predicted digestible nitrogen and/ or weed management areas	Removal of tree thinning Reduced planting rates Reduced management area	800 trees are estimated to be planted in a reduced 'enrichment only' management area shown in Figure 1 (54.1 ha)
-	Plant preferred koala browse trees in areas subject to intense weed management works. Planting opportunities would occur in spaces generated from the removal of high-density occurrences of Lantana (<i>Lantana camara</i>) and African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>).	New	3,700 trees are estimated to be planted in the 'weed' management area shown in Figure 1 (149.7 ha)

10. The Tree Canopy Nutrient Enrichment Program, as amended above, is anticipated to generate an increase in preferred koala browse trees throughout the proposed Conservation Area by an estimated 4,500 to 5,000 trees. No tree thinning is proposed to assist in this amended less intense enrichment program.

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Figure 1

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Predicted Benefit

11. As part of a wider suite of impact minimisation and mitigation measures, the Tree Canopy Nutrient Enrichment program is designed to support life cycle stages of the koala (i.e. reproduction, growth, development, aging and death) for individuals located within the proposed Conservation Area and those within the Kings Hill koala hub, as defined by BioLink (2018, 2019). More broadly, it is expected that this and other measures will maintain a capacity for individuals of the local population to successfully complete all life cycle stages under normal conditions thus maintain the population viability.
12. Encouraging the growth of preferred koala browse tree species in the Conservation Area is expected to generate additional browse for the koala in the medium term (i.e. 7-20 years) where progressive habitat loss is also proposed. Maximum benefit is expected in the longer term (i.e. 20-50 years) as these trees mature and form part of the canopy (i.e. increased biomass production in mature trees). This benefit will complement other positive effects expected from threat management (i.e. wild dog control, mortality from vehicle strike, bush fire management) and revegetation works proposed around wetland 803, other selected treeless parts of the Conservation Area and proposed stormwater detention basins, where adjoining to and accessible from the Conservation Area.
13. The expected increase in mean digestible foliar nutrients (i.e. available nitrogen) at the landscape scale (i.e. proposed Conservation Area), as a consequence of the amended Tree Canopy Nutrient Enrichment program, will have a beneficial influence on the forests carrying capacity (Au et al 2019), which is likely to have a corresponding beneficial effect on reproductive success (DeGabriel et al 2009). Holistically, this mitigation measure will arrest ongoing and unabated loss in habitat integrity arising from unmanaged forest degradation (e.g. reduced tree canopy recruitment stemming from an absence of low intensity mosaic fires and uncontrolled weed invasions). The 'no change to management' (Camus et al 2022) or 'Do Nothing' approach will likely result in the decline of the local population.
14. 'Normal conditions' are expected to prevail within the proposed Conservation Area following consideration of the broader mitigation works and in-perpetuity protection of this part of the larger Kings Hill hub habitat patch (i.e. the proposed Conservation Area represents ~25% of the minimum habitat area required for a viable koala hub). Accordingly, it is considered that life cycle processes or stages of koala individuals that form part of the Kings Hill hub are likely continue and, consequently, not threaten the viability of this local population such that it would be placed at risk of extinction.



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