OFFSET REVEGETATION PLAN

Introduction

28 South Environmental Pty Ltd (**28 South**) has prepared this Offset Revegetation Plan (**ORP**) as part of the broader Offset Area Management Plan (**OAMP**) submitted for the North Maclean Industrial Development (the **Proposed Action**) that is being assessed as a Controlled Action and which is progressing through the Preliminary Documentation phase subject to conditions of the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**) under the *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) (DCCEEW Ref: **2022/09304**). For clarity, this ORP has been prepared to guide on-ground restoration works with regard to the on-ground ecological restoration works, their goals and completion criteria. The overarching OAMP provides guidance on how the Offset Site achieves the goals of the DCCEEW Environmental Offsets Policy.

Significant residual impact associated with the Proposed Action will require the Proponent to provide an offset for the significant residual impact to listed threatened species under the EPBC Act, specifically the koala and grey-headed flying-fox. The Proponent owns the land upon which the rehabilitation will occur and will legally secure the offset area (the Offset Receiving Site (**ORS**)) via Voluntary Declaration under the *Vegetation Management Act 1996* and being assigned a Category A area of Regulated Vegetation under the *Planning Act 2017*. Maclean Estates Pty Ltd will commission an approved rehabilitation contractor to undertake the offset works generally in accordance with this ORP and its Environmental Objectives to manage and protect the offset in perpetuity as defined within the OAMP.

As detailed within the overarching OAMP, the ORS will result in a direct conservation outcome for the koala and grey-headed flying-fox in accordance with the EPBC Acts Environment Offset Policy and Environmental Objectives of the OAMP through the restoration of existing habitat, re-establishment/ creation of diverse and functional ecosystems providing greater additionality to adjoining large intact remnants. Further, the ORS will build upon the extent of a state significant biodiverse area immediately to the west at Calvert and the existing Queensland blue gum (noted as a key foraging species for both target matters) dominated vegetation to the west and north. Through this, a consolidated regionally significantly area of important foraging habitat will be established, with the site strategically positioned as a staging point for rehabilitation of broad areas of Queensland blue gum woodland to open forest on the alluvial plains.

Offset Receiving Site

The ORS is situated on a dual property at 454-544 and 418-452 Rosewood Laidley Road, Lanefield (Lot 2 on RP200424 and Lot 70 on CH31316) held in freehold title. The ORS is situated in the centre-west of the Ipswich City Council (**ICC**) Local Government Area (**LGA**) adjoining the Lockyer Valley Regional Council LGA and the Brisbane City Council LGA. The property totals 113.18 ha and the ORS comprises the entirety of the site. This area encompasses approximately 45.58 ha of remnant and high value regrowth vegetation and 67.60 ha of non-remnant vegetation historically cleared for the establishment of pasture.

Purpose of this ORP

The intent of this ORP is to outline the Environmental Objectives of the OAMP and how the ORS will be managed including:

a) The proposed treatments across the ORS such as;

i. The components of the ORS which will be subject to assisted natural regeneration methods where parts of the ORS currently support regrowth native vegetation communities.

ii. The component of the ORS which will be subject to active restoration and infill planting where parts of the ORS currently support some native vegetation, principally native shrubs and canopy elements in the ground layer (noting high levels of native woody recruitment); and

b) How the on-ground progress will be managed, monitored and reported upon.

This ORP has also been prepared in accordance with the requirements of the OAMP prepared for the Action and the South East Queensland Ecological Restoration Framework.

Restoration Area Management Strategies

The ORS and the areas proposed to be restored and managed as part of the Proposed Action's Offset have been illustrated on **ORP001.** A number of Management Units (**MU**) has been identified within the ORS and are derived from existing on-ground condition within these areas. Management measures for each MU have been derived from in-field detailed inspection and prepared in line with the SMART principals (Specific, Measurable, Achievable, Realistic & Timed) to achieve the Environmental Objectives of the OAMP. These management measures have also been prepared in concert with the Offset Land Management Actions and Corrective Actions outlined within the OAMP.

Management measures have also been prepared to ensure that temporal conditions can be reacted to and place greater accountability on the offset provider to utilise the most appropriate measures based on the proposed Environmental Objectives and on-ground temporal conditions (i.e. if good native recruitment is occurring at the time of works, tube stock plantings may not be required or can be significantly reduced, conversely, increasing weed incursion during works may require further weeding and increased tube stock plantings, drought conditions may require increased watering events through irrigation set ups). Specifications encourage the active natural regeneration from the seed bank where possible as this is the best means of establishing a robust, resilient and self-sufficient native ecosystem that is genetically suited to its endemic conditions.

Timing for Commencement of Works

The works outlined within this ORP must commence in concert with the Proposed Action (i.e. clearing and construction works on the Impact Site for the Proposed Action. Following initial establishment of the works, the ORS will be subject to ongoing management for the 20-year maintenance period and monitoring for the life of the Action's Approval (until 2053).

Maclean Estates Residential Development
Offset Revegetation Strategy

ORP001

28 South Project Ref: 2023-033

Source: D:\Dropbox\(d) Projects\2022\2022-033 (North Macelan No. 2)\(d) Data\(d) GIS

Data Sources: Aerial Imagery (Nearmap/Qld Globe); Digital Cadastre Database (DNRME, 2021); Roads (DNRME, 2020); Watercourse (DNRME, 2020); Contours (DNRME 2016).

Legend

- Site Boundary
- Planning Cadastre
- Watercourse
- AU1 - Regrowth RE 12.9-10.7 [3.43 ha]
- AU2 - Regrowth RE 12.3.19 [4.10 ha]
- AU3 - Regrowth RE 12.3.18 [1.18 ha]
- AU4 - Regrowth RE 12.3.3 [36.88 ha]
- AU5 - Regrowth RE 12.3.3 [67.60 ha]
- Management Unit 1 [45.58 ha]
- Management Unit 2 [61.80 ha]
- Management Unit 2b [2.56 ha]
- Management Unit 2c [3.24 ha]

Issue Date	Dwg No.	Author
2023-03-07	2023-033-RMP001	JD
Approved	**Revision Note**	
AD		

GDA2020 MGA 56

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Management Unit 1 – Management Strategy

Management Unit 1 (**MU 1**) (refer **Inset 1**) encompasses all of the western portion of the ORS apart from a component in the centre southwest which requires more intensive restoration methods. This MU mirrors the State mapped High value regrowth on the ORS and this vegetation reflects the most mature section on the ORS. This area totals 45.58 ha in area and supports a mix of Regional Ecosystem (**RE**) typologies. The MU has been split into sub-units based on the differing Regional Ecosystem typologies - refer to **ORP001**. Within these MUs the ground layer comprises a significant number and coverage of native species; while sporadic occurrences of pest plant species including lantana (*Lantana camara*) and common herbaceous weeds occur scattered throughout; disturbance is minimal with some small evidence of farm tracks throughout the MU. It is expected that continued exclusion of cattle and any other introduced herbivores (i.e. pigs, goats, deer or wild horses) and weed management measures will greatly enhance the MU's ability to naturally regenerate to a fully layered and self-sufficient ecosystem.

Assisted Natural Regeneration Requirements

The Assisted Natural Regeneration (**ANR**) management approach to this MU will take advantage of the emerging natural resilience and functionality of the existing communities, while promoting the regeneration of native vegetation through the removal of stock and exotic weed species. The main focus within this MU is to undertake targeted pest plant treatment and removal to encourage the natural recruitment of endemic native species from the seed bank. Seed of local provenance is key to successfully creating resilient and ultimately self-sufficient ecosystems as the seed is derived from parent plants lineage evolved in a site's microclimates. The commencement of the restoration works will also coincide with de-stocking of the ORS to remove any cattle and commencement of pest fauna management. Limited planting is proposed for most REs of this MU unless regeneration of various other canopy and shrub species are shown to be lacking from the ANR suite of species or weed eradication target areas do not show signs of native recruitment after a short period of time. Planting the area encompassing the Regrowth **RE 12.3.3** is recommended due to its lower density but this should occur after the weed treatment and observed lack of native recruitment. Revegetation should be undertaken utilising native tube stock, derived from locally sourced and grown species. Cherish will work closely with local native nurseries to establish a supply of tube stock to sufficiently support these areas. Seed collection from the ORS should also be considered over the course of management. All plantings are to be derived from the planting palette's analogous with each Sub-Unit RE in **Table 1**, **Table 2, Table 3** and **Table 4**.

Presently, there are no extensive areas of weed development within the MU and so only chemical methods for weed removal are prescribed herein (to avoid machinery impacting any native recruitment); however, it is at the discretion of the restoration contractor to use the most suitable, sensitive and adaptive methods. The engaged contractor will undertake an initial intensive weed management program to identify the pest plants occurring at the time of restoration works. All weed treatment and removal methods should be in accordance with the methods specified in the *South East Queensland Ecological Restoration Framework Manual.*

Assisted Natural Regeneration Management Actions

The primary objectives and performance criteria of ANR efforts proposed for MU 1 include:

- Remove stock and any fencing causing impediment to native fauna movement (i.e. barbed wire fencing)
- Retain and enhance all existing native fauna habitat
- Increase the extent of native vegetation cover over time
- Prior to planting out of the ORS the engaged contractors are to establish a 3 primary bio-condition plots and 3 tertiary site plots for on-going monitoring consistency, demarcated by steal posts or wooden bollards sufficient to last the 20 year monitoring period.
- Where practicable improve habitat connectivity and reduce fragmentation through encouragement of native recruitment
- Reintroduce large woody debris and other habitat features (fabrication of habitat qualities from left over timber elsewhere which would ordinarily go into green waste facilities)
- Weeds of National Significance (WoNS) and weed species listed under the *Biodiversity Act 2014* (**BA**) are not to be present within MU 1
- Evidence of significant reductions in the presence of other exotic species. It is considered appropriate that the following performance criteria be adopted:
    - o all large weed trees and woody weeds are to be removed or treated in-situ (to ensure they will not re-sprout/re-seed)
    - o scattered groundcover weed species may occur in very low densities where they perform important soil retention functions; however, no WoNS or BA weeds are to be present
        - ▪ pastoral grasses which do not impact the ultimate goal (restoring habitat for target MNES) are not considered to be weeds that require removal (however, native grasses/herbs and forbs should be preference)
    - o all weed treatment must be performed in a manner which does not promote erosion or instability of creek banks or soil
- Undertake baseline monitoring for feral predator/herbivore usage and management with ICC
- Bushfire monitoring and management in conjunction with the QFES and ICC
- Routine monitoring of the restoration area must also identify and rectify the following impacts:
    - o litter and/or rubbish dumping
    - o plant theft
    - o fauna impacts
    - o soil compaction
    - o erosion.

Timing assigned to these goals is variable and will be benefited by works being afforded a 20-year life span.

Inset 1: Current condition of Management Unit 1

Management Unit 2 – Management Strategy

Management Unit 2 (**MU 2**) (refer **Inset 2**) encompasses all of the remaining, eastern portion of the ORS and the aforementioned excluded centre southwest segment - refer to **ORP001**. This MU reflects the least mature section on the ORS and supports an eastern running unnamed tributary of Western Creek. This area totals 67.60 ha in area and supports the RE typology **12.3.3** (**Table 4**) with a central, ephemeral wetland area which will be reconstructed to support **RE 12.3.8** (**Table 5**) and three select areas in the north of the Site being the subject to translocated propagules for *Melalueca irbyana* (swamp tea-tree), collected as seeds from the Proposed Actions impact site. The ephemeral wetland areas will be a discrete sub-unit to MU 2, called **MU 2b** with a species planting palette. The areas subject to translocation of propagules will be known as **MU 2c**, with a specific planting palette analogous with **RE 12.3.18** (**Table 3**). MU 2 wholistically displays a pasture ground layer which dominates the stratum with some occurrences of native trees; and there are some incursions of pest plant species and common herbaceous weeds; disturbance is high with large agricultural pastures, ancillary structures and a dwelling dominating within the MU. There are some native trees highly scattered through the MU which will be key veteran trees within the regenerating ecosystem over time. It is expected that continued exclusion of cattle and any other introduced herbivores (i.e. pigs, goats, deer or wild horses) and weed management measures will greatly enhance the MU's ability to regenerate.

Reconstruction Requirements

The Reconstruction management approach to this MU will take advantage of the unchanged site topography (no earthworks required to undertaken reconstruction methods) to promote the regeneration of native vegetation through the removal of stock and exotic weed species and critically, the in-fill planting of species analogous with the ground-truthed **RE 12.3.3**, desired **RE 12.3.18** and the *Melaleuca irbyana* translocation respective to the sub-unit. The first focus within this MU is to undertake targeted pest plant treatment and removal to enable the natural and planted recruitment of native species from the seed bank and planting palette. The commencement of the reconstruction works will also coincide with de-stocking of the ORS to remove any cattle. Revegetation should be undertaken utilising native tube stock, derived from locally sourced and grown species at the rates and densities outlined in **Table 4** and **5**. MU 2b's requirements are largely congruent with that of its parent, with a specific focus on wetland areas and sensitive management around wet areas. MU 2c will be subject to propagated *Melaleuca irbyana* seed collected from the impact site to establish a community homogenous with that of the impact site to compensate for its loss. Cherish will work closely with local native nurseries to establish a supply of tube stock to sufficiently support these areas. All plantings are to be derived from the planting palettes in **Table 4** and **Table 5**. Seed collection from the ORS should also be considered over the course of management. It is noted that not all species may be available at the time of works. Subsequent species listed under the Regional Ecosystem Definition Data (**REDD**) prepared by the Queensland Herbarium must be consulted to identify other appropriate species for planting.

Regular maintenance must be undertaken to ensure plant establishment is successful and any failed plantings can be appropriately replaced to ensure the achievement of 1 plant per 1 m2. Further, regular monitoring must coincide with weed management to remove pest plants that may continue to persist within the MU. Mechanical and chemical methods for weed removal are prescribed and it is at the discretion of the Restoration Contractor to use the most suitable method. All weed treatment and removal methods must be undertaken in accordance with the methods specified in the South East Queensland Ecological Restoration Framework Manual.

Ecological Reconstruction Management Actions for MU 2 and MU 2b

The primary objectives and performance criteria of the Reconstructive efforts proposed for MU 2 include:

- Remove stock and any fencing causing impediment to native fauna movement (i.e. barbed wire fencing)
- Retain and enhance all existing native fauna habitat and existing veteran trees
- Prior to planting out of the ORS the engaged contractors are to establish a 3 primary bio-condition plots and 3 tertiary site plots for on-going monitoring consistency, demarcated by steal posts or wooden bollards sufficient to last the 20 year monitoring period.
- Plant out the ORS utilising tubestock from **Tables 4** and **5** in line with the Landscape treatment sections below
- Water in plantings and closely maintain these for an establishment period of 3 months or longer based on growth success goal attainment.
- Increase the extent of native vegetation cover over time
- Where practicable improve habitat connectivity and reduce fragmentation through encouragement of native recruitment and where possible the installation of nesting boxes in veteran trees.
- Reintroduce large woody debris and other habitat features
- WONS and weed species listed under BA are not to be present within MU 2
- Evidence of significant reductions in the presence of other exotic species. It is considered appropriate that the following performance criteria be adopted:
    - all large weed trees and woody weeds are to be removed or treated in-situ (to ensure they will not re-sprout/re-seed)
    - scattered groundcover weed species may occur in very low densities where they perform important soil retention functions; however, no WoNS or BA weeds are to be present
        - pastoral grasses which do not impact the ultimate goal (restoring habitat for target MNES) are not considered to be weeds that require removal
    - all weed treatment must be performed in a manner which does not promote erosion or instability of creek banks or soil
- Undertake baseline monitoring for feral predator/ herbivore usage and management with ICC
- Bushfire monitoring and management in conjunction with the QFES and ICC
- Routine monitoring of the restoration area must also identify and rectify the following impacts:
    - litter and/or rubbish dumping
    - plant theft
    - fauna impacts
    - soil compaction
    - erosion.

Timing assigned to these goals is variable and will be benefited by works being afforded a 20-year life span.

Ecological Reconstruction Management Actions for MU 2c

A total of 3600 *Melaleuca irbyana* will be propagated from seed collected from the Subject Site, as follows:

- Seed capsules will be collected prior to vegetation clearing.
- Planting will be carried out when the site is relatively dry to allow vehicle and machinery access. This will probably be between August and December but may be changed according to weather conditions. The Translocation Contractor is to determine the most appropriate time of year for planting.
- The corners of four Planting Areas within the Recipient Site will be pegged (e.g. zinc alum star picket painted white) and the coordinates recorded with a GPS.
- Prior to the commencement of planting, pasture and weeds in a circle of radius 50 cm will be sprayed with herbicide and left for 2-3 weeks before planting. Patches with good quality native ground cover should be avoided. All weed management works shall be conducted by suitably experienced Revegetation Contractor or Bush Regenerator with appropriate native and weed species identification skills, under supervision of the Translocation specialist.
- The dense M. irbyana thickets in the impact site have a closed forest structure like rainforest and therefore a rainforest planting model could be used. In rainforest revegetation, tree spacing is typically 1.8 m, so for 1 ha 3000 tubestock are required. To achieve the dense, monospecific stand of M. irbyana, plant spacing will be 2m x 2m, or 2500 per ha.
- A total of 5600 will be planted at the Recipient Site and 1000 kept in reserve for replacements or additional plantings if needed.
- All plants shall be:

- Watered 1 – 2 hours prior to planting;
- Planted with 12-month slow-release fertiliser;
- Watered, on the day of installation until soil is moist to 30 cm in depth.
- Follow-up watering shall be applied to ensure the soil does not become excessively dry.
- Watering is required to be undertaken every 2-3 days for the first two weeks;
- Watering is required once every 4-5 days for the following five weeks; and
- Watering once every 1-2 weeks until the completion of the Establishment Period.

- Where mulch is deemed to be required by the Translocation Contractor, the mulch shall be weed free and installed within three days of the completion of planting, spread to 50 mm and installed at the base of plants and only mulch free of weed seed will be used.

The establishment period (minimum 90 days) will commence after successful planting where the translocation is assessed for health. After the completion of this period, maintenance will be carried out to ensure the plantings remain healthy and actively growing. The timing for each of these periods is variable and greater detail regarding the translocation process can be found in the *Melaleuca irbyana Translocation Plan* found in **Attachment 1**.

Inset 2: Current condition of Management Unit 2

Planting Palette

The species list and target density for planting in **Tables 1, 2, 3, 4 & 5** have been derived from Regional Ecosystem Technical Descriptions (https://www.publications.qld.gov.au/dataset/re-technical-descriptions).

Table 1: Planting palette **RE 12.9-10.7**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (~6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Corymbia tessellaris	Moreton bay ash	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
Acacia disparrima	Southern salwood	10%	
Acacia neriifolia	Oleander wattle	10%	
Corymbia intermedia	Pink bloodwood	10%	
Shrub			
Acacia leiocalyx	Black wattle	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Acacia salicina	Native willow	33%	
Alphitonia excelsa	Red ash	33%	
Groundcover			
Themeda triandra	Kangaroos grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Cymbopogon refractus	Barbed wire grass	30%	
Aristida gracilipes	Three-awn speargrass	20%	
Chloris divaricata	Slender chloris	20%	

Table 2: Planting palette **RE 12.3.19**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (~6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Corymbia tessellaris	Moreton bay ash	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
Acacia disparrima	Southern salwood	10%	
Acacia neriifolia	Oleander wattle	10%	
Corymbia intermedia	Pink bloodwood	10%	
Shrub			
Acacia leiocalyx	Black wattle	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Acacia salicina	Native willow	33%	
Alphitonia excelsa	Red ash	33%	
Groundcover			
Themeda triandra	Kangaroos grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Cymbopogon refractus	Barbed wire grass	30%	
Aristida gracilipes	Three-awn speargrass	20%	
Chloris divaricata	Slender chloris	20%	

Table 3: Planting palette **RE 12.3.18**

Botanical Name	Common Name	Dominance (%)	Density
Canopy			
Eucalyptus tereticornis[1]	Queensland blue gum	45%	Canopy plantings should be established at 1/40m² (6.3m spacing)
Eucalyptus crebra	Narrow-leaved ironbark	10%	
Allocasuarina luehmannii	Bull-oak	10%	
Dockrillia linguiformis	Tounge orchid	5%	
Sub-canopy and Shrub			
Melaleuca irbyana	Swamp tea-tree	15%	Sub-canopy and shrub plantings should be established at 1/36m² (6m spacing)
Acacia leiocalyx subsp. leiocalyx	Black wattle	15%	
Alphitonia excelsa	Red ash	10%	
Alstonia constricta	Quinine bush	10%	
Groundcover			
Paspalidium distans	Shotgrass	10%	Groundcover plantings should be established at 1/1m² (~1m spacing)
Themeda triandra	Kangaroo grass	20%	
Enteropogon unispiceus	Windmill Grass	15%	
Digitaria breviglumis	Short-glumed umbrella grass	15%	

[1] Species denoted with * are winter-flowering species

Table 4: Planting palette **RE 12.3.3**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
Eucalyptus tereticornis[2]	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Lophostemon suaveolens	Swamp box	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
*Melaleuca quinquenervia**	Broad-leaved paperbark	10%	
Acacia disparrima subsp. disparrima	Hickory wattle	10%	
*Banksia integrifolia**	Coast banksia	10%	
Shrub			
*Alphitonia excelsa**	Red ash	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Petalostigma pubescens	Quinine bush	33%	
Jacksonia scoparia	Dogwood	33%	
Groundcover			
Eremochloa bimaculata	Poverty grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Imperata cylindrica	Blady grass	30%	
Heteropogon contortus	Black spear grass	20%	
Themeda triandra	Kangaroo grass	20%	

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[2] Species denoted with * are winter-flowering species

Table 5: Planting palette **RE 12.3.8 (Management Unit 2b)**

Botanical Name	Common Name	Dominance (%)	Density*
Canopy			
*Eucalyptus tereticornis**[3]	Queensland blue gum	30%	Canopy plantings should be established at 1/40m² (6.3m spacing)
*Eucalyptus crebra**	Narrow-leaved ironbark	40%	
Angophora leiocarpa	Smooth-barked apple	20%	
Sub canopy			
Lophostemon suaveolens	Swamp box	10%	Sub-canopy plantings should be established at 1/20m² (~13m spacing)
*Melaleuca quinquenervia**	Broad-leaved paperbark	10%	
Acacia disparrima subsp. disparrima	Hickory wattle	10%	
*Banksia integrifolia**	Coast banksia	10%	
Shrub			
*Alphitonia excelsa**	Red ash	33%	Shrub plantings should be established at 1/16m² (~4 m spacing)
Petalostigma pubescens	Quinine bush	33%	
Jacksonia scoparia	Dogwood	33%	
Groundcover			
Eremochloa bimaculata	Poverty grass	30%	Groundcover plantings established at 1/1m² (~1 m spacing)
Imperata cylindrica	Blady grass	30%	
Heteropogon contortus	Black spear grass	20%	
Themeda triandra	Kangaroo grass	20%	

[3] Species denoted with * are winter-flowering species

Landscape Specifications

Maintenance

The minimum following maintenance measures are required to be undertaken by the contractor:

- Planting areas are to be regularly watered for a period of 12 weeks or as deemed necessary by the contractor to ensure establishment is successful or until sufficient rainfall is received; and
- Recurrent listed WoNS or BA weeds within regeneration areas are to be removed (weed management measures are outlined within **Table 6**);

Planting Requirements

Table 1-4 identify the appropriate species to be selected for planting as well as the density criteria to be achieved. It is noted that not all species proposed may be available at the time of works. Subsequent species listed under the Regional Ecosystem Definition Data (REDD) prepared by the Queensland Herbarium should be consulted to identify other appropriate species for planting. If all species required for planting are not available, a staged planting may be required. This must be supported in writing from the Assessment Manager/Team.

Site Clean-up & Waste Management

Hazards and wastes are removed from the development site; this includes:

- any wastes as defined in the *Environmental Protection Act 1994*;

- machinery, fencing or equipment left over from past uses and practices; and

- items of rubbish and litter.

It is noted that site surveys did not identify any significant waste material. Contractors should be made aware of any contaminates or waste material prior to undertaking works.

Sediment and Erosion Control

The engaged contractor must install silt control fencing as required on site, to prevent soil material from entering restoration areas or leaving restoration areas. If soil stabilisation measures are required within the MUs to assist in the avoidance, minimisation and mitigation of soil loss, they should be sympathetic to the specific situation and only utilise appropriate measures such as sediment fencing, coir logs or native mulch.

Fire Ant Movement Controls

To prevent the spread of fire ants, the Queensland Government has implemented controls that apply to individuals and commercial operators, to restrict the movement of materials that could carry fire ants including soil, turf, potted plants, mulch, baled hay or straw, animal manures mining or quarry products. Penalties apply for non-compliance with the movement controls. If the engaged contractors are unsure of their obligations under the *Biosecurity Act 2014* they should contact the relevant Queensland State Government Department.

Contractor Requirements

All weed treatment must be safely undertaken by a suitably qualified contractor and utilise appropriate chemicals and all contractors must have Conservation and Land Management Certification 4 or equivalent experience and an ACDC licence.

This RMP has been based on best practices from the SEQ Ecological Restoration Framework and significant practical experience in restoration implementation projects.

Services

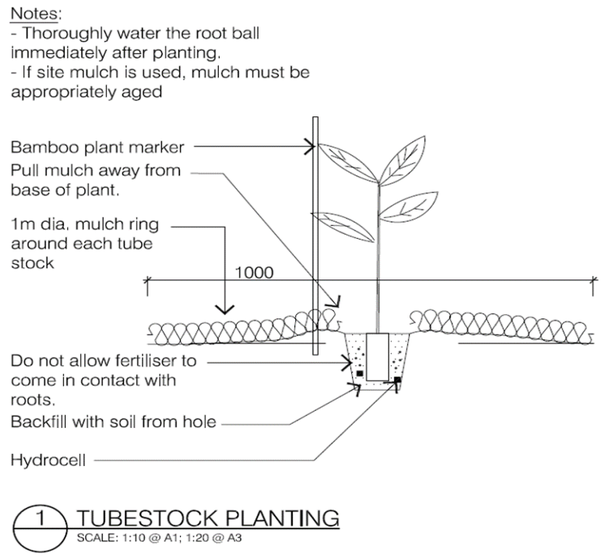
The contractor shall make themselves aware of all underground and overhead services prior to the commencement of works. The contractor shall also be responsible for determining the locations of as-built and to be constructed services during the course of the works. No services have been identified on these drawings.

Controlling Domestic Pets and Wildlife

It is important to exclude domestic pets and wildlife from restoration areas during the formative periods of the restoration efforts. This will help avoid the loss of tube stock or regenerating vegetation from being impacted and or loss through foraging.

Landscape Specification Notes for Planting

1. Ensure all water crystals are thoroughly wetted before application and fertiliser applied at the nominated rate.
2. Compensatory Planting Treatments: remove all weeds and install planting as noted. Provide a bamboo marker at each tube stock location that extends 300mm above the ground and has the top 100mm painted white or pink.
3. Planting is to be undertaken in accordance with the below diagram - Tubestock Planting 1.
4. It is the responsibility of the engaged contractor to determine the final location of each planting. This location should take into account the position of any existing vegetation retained within the Site and the necessary maintenance of the MU.



Each specimen will be watered-in with at least 5 litres of water; fertiliser and water crystals; and surrounding with a 0.5m ring of clean native mulch to a depth of 50mm. Landscape specifications for plants are outlined below and within *Tube Stock Planting Note 1*.

Table 6: Control techniques and herbicide application rates

Common Name	Scientific Name	Application Method	Chemical	Application Rate
Trees				
Camphor laurel	*Cinnamomum camphora*	Stem inject	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Basal bark (saplings)	Fluroxypyr	
		Spot spray	Glyphosate, Glyphosate + Metsulfron methyl	
Chinese celtis	*Celtis sinensis*	Cut stump and paint, stem injection	Triclopyr 200g /L plus picloram 100 g/L	
		Stem injection, cut stump and paint	Glyphosate 360 g/L	
		Spot spray	Fluroxypyr 200 g/L	
Cadaghi	*Corymbia torelliana*	Spot Spray	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
		Basal bark (saplings)	Fluroxypyr	
Umbrella tree	*Schefflera actinophylla*	Spot Spray	Glyphosate + Metsulfron methyl	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
Giant devils fig and wild tobacco	*Solanum chrysotrichum* and *S. mauritianum*	Spot spray	Glyphosate, Fluroxypyr	
		Cut, scrape and paint	Glyphosate	
		Basal bark (juvenile / mature)	Fluroxypyr	
		Stem inject	Glyphosate	
African tulip tree	*Spathodea campanulata*	Spot spray	Glyphosate	
		Cut, scrape and paint	Glyphosate	
		Stem inject	Glyphosate	
Cocos palm	*Syagrus romanzofffiana*	Stem inject	Glyphosate + Metsulfron methyl	
		Spot spray	Glyphosate + Metsulfron methyl	
Shrubs				
Easter Cassia	*Senna pendula var. glabrata*	Spot Spray	Glyphosate	
		Cut Scrape Paint	Glyphosate	
		Stem Inject	Glyphosate	
Lantana	*Lantana camara*	Cut, Scrape and Paint	Glyphosate	
		Spot-spray	Fluroxypyr	
		Spray (spot spray and	Glyphosate	
Brazilian peppertree	*Schinus terebinthifolius*	Spot spray	Glyphosate	
		Cut scrape paint	Glyphosate + Metsulfuron Methyl	
		Basal barking	Fluroxypyr	
Groundsel	*Baccharis halimifolia*	Spot Spray, Stem Inject, Cut Scrape Paint	Glyphosate	
		Spot Spray	2,4-D	
Yellow bells	*Tecoma stans*	Cut stump method	Triclopyr 200g /L plus picloram 100 g/L	
		Spot spray	Glyphosate	
		Basal barking	Fluroxypyr	
		Stem injection	Glyphosate	
Groundcovers and grasses				
Singapore Daisy	*Sphagneticola trilobata*	Spot-spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Pink Lady	*Callisia repens*	Culture burn	Glyphosate	

Herbicides must be applied by appropriately qualified / supervised persons in accordance with the Agricultural Chemicals and Distribution Control Act 1966 at rates as identified on registered product labels, or on an Australian Pesticides and Veterinary Medicines Authority (APVMA) issued permit where applicable. Refer to the South East Queensland Ecological Restoration Framework for addition guidance.

Common Name	Scientific Name	Application Method	Chemical	Application Rate
		Spot Spray		
Blue billy goats weed	*Ageratum houstonianum*	Spot Spray	Glyphosate	
			Metsulfuron Methyl	
Singapore Daisy	*Sphagneticola trilobata*	Spot-spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Basket asparagus	*Asparagus aethiopicus*	Spot Spray	Glyphosate + Metsulfuron Methyl	
			Metsulfuron Methyl	
Red Natal, South African Pigeon Grass, Molasses Grass, Para Grass, Rhodes Grass, Guinea Grass, Elephant Grass, Signal Grass	*Melinis repens, Setaria sphacelata, Melinis multiflora, Urochloa mutica, Chloris gayana, Megathyrsus maximus*, *Pennisetum purpureum, Urochloa decumbens*	Spot Spray	Glyphosate	

Monitoring

Monitoring is important to understand the gradual improvement and eventual achievement of the offset obligation, which will ultimately result in the net-benefit for the two listed threatened species (koala and grey-headed flying-fox). It is also noted that the re-establishment of two Threatened Ecological Communities (**TEC**) will be benefited by the proposed ORS. Detailed monitoring will be undertaken throughout the ORS with a minimum of 3 Primary monitoring sites established for each MU (i.e. minimum of 6 primary monitoring sites across the ORS)**.** A further 3, tertiary monitoring sites are also to be established within each MU where tertiary monitoring is to be undertaken as a means of ensuring adequate coverage capturing growth, cover and species richness and assisting in the insurance of goals being met. Monitoring should include the collection of Key Performance Indicators[4] as indicated in **Table 7** below as well as any opportunistic observations of species koala and grey-headed flying-fox. During each monitoring event, photos should be collected in the centre of each monitoring site and taken in cardinal directions. Any other additional photographic evidence of the parameters being monitored should also be collected and recorded where appropriate. Monitoring is to be undertaken once per annum for the first 3 years, biennially until year 10 and then every five years until the expiry of the approval (2052) with audit reporting submitted to DCCEEW following each 5 year milestone. Refer to **Table 9**.

Table 7: Monitoring of Key Performance Indicators (KPIs) for Primary Monitoring Sites

Key Performance Indicators	Description	20+ year Goal
Bio-condition Parameters		
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.	The ultimate goal of all KPIs is to achieve, at a minimum the proposed upswing in Condition Scoring for each individual MU (based on a weighted scoring of Assessment Units described in **Attachment 11** of OAMP).
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)	
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).	
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.	
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.	
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).	
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.	
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.	
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.	
Native Species Richness – Forbes	Record the number of native forbs species occurring in the monitoring site.	
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)	
Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)	
Additional Restoration Parameters		
Dominant Species	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers	N/A
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.	
Plant Failure	Notation and number of natural death or illegal removal of established plantings	
Flowering Trees	Monitoring should be focused on periods during late winter to detect the presence of flowering and the relative density for flowering within the MU (and ORS generally)	

Tertiary monitoring sites should be established to provide greater coverage over the ORS to ensure rehabilitation works as a whole are trending towards the ultimate goals and Environment Objectives of the OAMP. Tertiary monitoring aims to track the major KPIs. Failure of the KPIs will trigger a review of management measures and potentially corrective actions (Refer to OAMP). KPIs for the Tertiary monitoring sites are outlined in **Table 7**. Tertiary monitoring sites are based on the Regional Ecosystem Vegetation Structure Assessment (CORVEG)[5]. Tertiary monitoring sites are to be monitored yearly to ensure trends in growth and/or management issues are detected and corrective actions can be immediately actioned where required. **Table 8** includes an auditing report proforma for the monitoring of KPIs. Each KPI for the ORS condition scoring has a significantly different ability to be achieved, particularly noting many are simply a result of the initial planting works or ANR (e.g. species richness, weediness etc.). As such, some KPIs will be achieved and maintained early; while others will require much of the +20 years to achieve.

Table 8: Monitoring of KPIs for tertiary monitoring sites

Key Performance Indicators	Description
Bio-condition Parameters	
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)
Additional Restoration Parameters	
Dominant Species	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.
Plant Failure	Notation and number of natural death or illegal removal of established plantings
Flowering Trees	Monitoring should be focused on periods during late winter to detect the presence of flowering and the relative density for flowering within the MU (and ORS generally)

On-ground fauna surveys for koala and grey-headed flying-fox are to be undertaken as part of each major monitoring event (5, 10, 15 and 20 years[6]) and are to be in accordance with the relevant Terrestrial Vertebrate Fauna Survey Guidelines for Queensland as well as Spot Assessment Technical (**SAT**) Surveys for Koala, spot lighting, diurnal bird surveys, incidental records during management activities.

[4] The auditor should develop a performer for the collection of information in Table 6/7 and in accordance with the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*

[5] Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2020) *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1*. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

[6] It is recommended monitoring be undertaken more regularly while rehab staff are on Site to improve the volume of study undertaken.

Table 9: Monitoring Schedule

Monitoring activity	Management needs/questions addressed	Parameter/s measured	Survey/monitoring guidelines	Where	When	Reporting Requirements
Baseline Surveys - Primary Monitoring Site Establishment	Establish an understanding of baseline values/condition of each of the monitoring sites across the ORS for comparison during the 20 year management timeframe and the ongoing auditing until 2050.	Refer to the KPI's in **Table 7/8** and specific completion criteria in **Table 10** and **11.**	KPI's have been adopted from the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*	At each of the 9 Monitoring Sites to be established across the ORS (a minimum of 3 per Management Unit)	Year 0 - Prior to the commencement of offset works and establishment (2022).	Annual Compliance Reporting
Monitoring of KPIs (9 Primary Monitoring Sites)	Undertake monitoring and auditing reporting for the primary monitoring sites. Report to DAWE on the ORS achievement of the KPIs and Completion Criteria.	Refer to the KPI's in **Table 7/8** and specific completion criteria in **Table 10** and **11.**	KPI's have been adopted from the *Queensland Government Guide to Determining Terrestrial Habitat Quality: A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (Version 1.3 2020).*	At each of the 9 Primary Monitoring Sites to be established across the ORS (a minimum of 3 per Management Unit)	Year 1 (2023)	
					Year 2 (2024)	
					Year 3 (2025)	
					Year 5 (2027)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 8 (2030)	Annual Compliance Reporting
					Year 10 (2032)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 15 (2037)	
					Year 20 (2042)	
					Year 25 (2047)	Annual Compliance Reporting
					Year 28 (2050)	
Monitoring of Secondary Sites (9 additional sites)	Undertake monitoring at the secondary sites.	General floristic structure and composition including the tree canopy heights (growth rates), assessment of plant health and failure, and extent of weed coverage.	Simplified assessment sheet that is based on the CORVEG Proforma and methodology from the *Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (Version 5.1 2020)*	At each of the 9 Secondary Monitoring Sites	Year 1 (2023)	
					Year 2 (2024)	
					Year 3 (2025)	
					Year 5 (2027)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 8 (2030)	Annual Compliance Reporting
					Year 10 (2032)	Annual Compliance Reporting **Reporting on Website** **Audit Report to DAWE**
					Year 15 (2037)	
					Year 20 (2042)	
					Year 25 (2047)	Annual Compliance Reporting
					Year 28 (2050)	
Targeted Fauna Surveys	Understanding of MNES Fauna Species Presence/Usage of the ORS	MNES Fauna Species Presence/Usage	Surveys are to be in accordance with the relevant Terrestrial Vertebrate Fauna Survey Guidelines for Queensland as well as Spot Assessment Technical (SAT) Surveys for Koala, spot lighting, diurnal bird surveys, incidental records during management activities.	At ORS in accordance with the Terrestrial Vertebrate Fauna Survey Guidelines.	**Year 5 (2027)**	
					Year 10 (2032)	
					Year 15 (2037)	
					Year 20 (2042)	

Table 10: Completion Criteria Scoring Table Proforma

Key Performance Indicators	Description	MUXX Benchmark Score	MUXX Baseline Score	MUXX Monitoring Year 5 Score	Increase in Score	MUXX 20+ year Goal	Required Increase to achieve Goal	Trending / Not Trending Towards and Recommendations
Bio-condition Parameters								
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.							
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)							
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).							
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy, sub-canopy and shrub.							
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).							
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site.							
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.							
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.							
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.							
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)							
Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)							
Additional Restoration Parameters								
Dominant Species*	Qualitative description of the floristic structure of the monitoring site for the tree, shrub and ground layers	N/A	N/A		N/A			
Assessment of plant health	Notation of plant health within the monitoring site. Notation of survival rate of plants where they have been established.	N/A	N/A		N/A			
Plant Failure	Notation and number of natural death or illegal removal of established plantings	N/A	N/A		N/A			

Completion Criteria

Completion criteria is directly linked to the KPI's listed in **Tables 7** and **8** as well as increases in Context and Species Stocking Rates Scores (which are also derived from the KPIs), with the gradual achievement contributing to the eventual satisfaction and completion of the offset works at the end of the 20-year maintenance period for the ORS. Completion criteria include:

- Achievement of Habitat Quality Scores at year 20.
    - All Habitat Quality Scores, are to be populated by detailed monitoring assessments (i.e. Bio-condition (MHQA) and fauna surveys) for the Offsets Condition scoring (at both East and West areas).
    - Context Scoring is directly linked to the achievement of regrowth and remnant status of the rehabilitation works. As such, achieving 50% (cover) and 70% (height) will attain Remnant Status, *as such achieving the proposed increases in Context scoring- a GIS metric*.
    - Species Stocking Rates will be assessed and accounted for during bio-condition survey efforts.
- Achievement of remnant status under the *Vegetation Management Act 1999*, whereby vegetation meets the 70% of the height and greater than 50% cover relative to the bio-condition benchmarks for targeted RE's. This is demonstrated through the following KPIs; Tree Canopy Height, Tree Canopy Cover, Native Species Richness – Trees and Dominant Species.
- Revegetation works must establish at least 1 koala habitat tree per 40m2 in accordance with the *Queensland Environmental Offsets Policy 2014*;
- No WoNS present and less than 10% coverage of other weeds listed under the BA are present within the ORS; and
- At least 90% survival rate of established plantings

Each audit report should state the progression towards achieving the Completion Criteria and when they have been met. The audit reporting should include the data in tabulated format as illustrated in **Table 9/10** & ultimately final results in **Table 11**. This information should be assessed at an ORS scale (i.e. all scores should be compiled to calculate the weighted total score for ORS MU1 and MU2 (MU2B & MU2C). **Tables 12a-b** illustrate the expected upswing in scores for each koala and grey-headed flying-fox over 5, 10, 15 and 20 years over the Site as an averaged whole.

Table 11: Completion Criteria – Habitat Quality Score Increases for MNES species

Monitoring Completion Criteria	Baseline Score	Year 5 Score	Year 10 Score	Year 15 Score	Year 20 Score
Total Condition Score /3	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)	Derived from results of Monitoring (Table 9)
Site Context Score /3	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)	Derived from GIS Analysis (MHQA Methods)
Species Stocking Rate Score /4	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results	Derived from Fauna Survey Results
Total Future Habitat Quality Score With Offset /10	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters	Sum of the above parameters

Triggers and Corrective Actions

The following Triggers, Corrective Actions and Timing outlined in **Table 12** are to be implemented in instances of non-compliance or a lack of success towards the gradual achievement of the Key Performance Criteria in **Table 6** and **7** and the Completion Criteria Scores at Years 5, 10, 15 and 20 in **Table 9**.

Table 12a: Completion Criteria for Koala – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Key Performance Indicators	Description	Baseline	Year 5 Score	Year 10 Score	Year 15 Score	Year 20 Score
	Site Condition (Bio-condition Parameters and KPIs)					
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.		**5/15** 0-50% of Benchmark	**5/15** 0-50% of Benchmark	**10/15** >50-110% of Benchmark	**10/15** >50-110% of Benchmark
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)		**3/5** >200% of Benchmark	**3/5** >200% of Benchmark	**5/5** >70% of Benchmark	**5/5** >70% of Benchmark
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).		**3/5** >20-75% of Benchmark	**3/5** >20-75% of Benchmark	**5/5** >75% of Benchmark	**5/5** >75% of Benchmark
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.		**3/5** >200% of Benchmark	**3/5** >200% of Benchmark	**4/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.		**3/5** >10%-<50% or >200% of Benchmark	**3/5** >10%-<50% or >200% of Benchmark	**3/5** >10%-<50% or >200% of Benchmark	**5/5** >50-<200% of Benchmark
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).		**2/5** <50% or >200% of Benchmark	**2/5** <50% or >200% of Benchmark	**2/5** <50% or >200% of Benchmark	**5/5** >200% of Benchmark
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.		**2.5/5** <25% of Benchmark	**2.5/5** <25% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.		**3/5** >25-90% of Benchmark	**3/5** >25-90% of Benchmark	**5/5** >90% of Benchmark	**5/5** >90% of Benchmark
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)		**3/10** >25%-50% of Benchmark	**3/10** >25%-50% of Benchmark	**3/10** >5-25% of Benchmark	**5/10** >5-25% of Benchmark
Native grass cover	Note the extent/occurrence pf native grass species		**1/5** >10-50% of Benchmark	**1/5** >10-50% of Benchmark	**3/5** >50-90% of Benchmark	**5/5** >90% of Benchmark

Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)		**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Quality and availability of food and habitat required for foraging			**5/10**	**5/10**	**5/10**	**10/10**
Quality and availability of habitat required for shelter and breeding			**5/10**	**5/10**	**5/10**	**10/10**
	Site Condition Score (out of 100)	**52.5 (baseline)**	**49.5**	**49.5**	**70**	**90**
	Site Condition Score (converted out of 3)	**1.57 (baseline)**	**1.49**	**1.49**	**2.1**	**2.7**
	Site Context					
Size of Patch			10/10	10/10	10/10	10/10
Connectedness			2/5	2/5	2/5	2/5
Context			4/5	4/5	4/5	4/5
Ecological Corridors			4/6	4/6	4/6	4/6
Threats to Species			7/15	7/15	7/15	7/15
Quality and availability of habitat required for mobility			5/10	5/10	10/10	10/10
	Site Context Score (out of 56)	35	32	32	37	37
	Site Context Score (converted out of 3)	**1.88**	**1.71**	**1.71**	**1.98**	**1.98**
	Species Stocking Rate					
Presence detected on or adjoining site			10/10	10/10	10/10	10/10
Species Usage (Habitat type & evidence of usage)			10/15	10/15	10/15	10/15
Approximate Density			10/30	10/30	20/30	20/30
Role/Importance of Species Population on Site			5/15	5/15	5/15	5/15
	Species Stocking Rate (out of 70)	35	35	35	45	45
	Species Stocking Rate (converted out of 4)	**2**	**2**	**2**	**2.57**	**2.57**
	Total Habitat Quality Score (out of 10)	**5.45* AU Weighting Factor of 0.809 (5.45*0.809 = 4.41 (Actual MHQA Score)**	**5.2 Averaged Scores for AUs Round to 5**	**5.2 Averaged Scores for AUs Round to 5**	**6.68 Averaged Scores for AUs Round to 7**	**6.68 Averaged Scores for AUs Round to 7**

Table 12b: Completion Criteria for Grey Headed Flying Fox – Example outlining how ORS performance will achieve OAMP goals and reach proposed ecological benefit in line with EPBC Offsets Policy.

Table 11b: Completion Criteria for Grey Headed Flying Fox**Key Performance Indicators**	**Description**	**Baseline (rounded)**	**Year 5 Score**	**Year 10 Score**	**Year 15 Score**	**Year 20 Score**
	Site Condition (Bio-condition Parameters and KPIs)					
Large trees	Number of large trees above the DBH size threshold defined by the target Regional Ecosystem bio-condition benchmark.		**10/15**	**10/15**	**10/15**	**10/15**
			>50-110% of Benchmark	>50-110% of Benchmark	>50-110% of Benchmark	>50-110% of Benchmark
Tree canopy height	Record the average height of each strata layer present (i.e. emergent, canopy, sub-canopy, shrub and groundcover layers)		**3/5**	**3/5**	**5/5**	**5/5**
			>200% of Benchmark	>200% of Benchmark	>70% of Benchmark	>70% of Benchmark
Recruitment of woody perennial species in EDL	Record the number of tree species that are being naturally recruited within the monitoring site (i.e. occurring as saplings <5cm DBH).		**3/5**	**3/5**	**5/5**	**5/5**
			>20-75% of Benchmark	>20-75% of Benchmark	>75% of Benchmark	>75% of Benchmark
Tree canopy cover	Percentage of 100m transect within the monitoring site that is covered by canopy and sub-canopy.		**3/5**	**3/5**	**5/5**	**5/5**
			>200% of Benchmark	>200% of Benchmark	>50%-<200% of Benchmark	>50%-<200% of Benchmark
Shrub Cover	Percentage of 100m transect within the monitoring site that is covered by shrub.		**3/5**	**3/5**	**3/5**	**5/5**
			>10%-<50% or >200% of Benchmark	>10%-<50% or >200% of Benchmark	>10%-<50% or >200% of Benchmark	>50-<200% of Benchmark
Coarse woody debris	Amount of coarse woody debris occurring within the monitoring site (in metres per site) (collected the length of wood debris that is >10cm in width and >0.5m in length).		**2/5**	**2/5**	**2/5**	**5/5**
			<50% or >200% of Benchmark	<50% or >200% of Benchmark	<50% or >200% of Benchmark	>200% of Benchmark
Native Species Richness – Trees	Record the number of native tree species occurring in the monitoring site. This is controlled by the planting palettes within the OMP.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Shrubs	Record the number of native shrub species occurring in the monitoring site.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Grasses	Record the number of native grass species occurring in the monitoring site.		**2.5/5**	**2.5/5**	**5/5**	**5/5**
			<25% of Benchmark	<25% of Benchmark	>90% of Benchmark	>90% of Benchmark
Native Species Richness – Forbes	Record the number of native forbes species occurring in the monitoring site.		**3/5**	**3/5**	**5/5**	**5/5**
			>25-90% of Benchmark	>25-90% of Benchmark	>90% of Benchmark	>90% of Benchmark
Extent of non-native/weed coverage	Note the extent/occurrence of weeds listed under the *Biosecurity Act 2014* or as a WoNS (percentage coverage within the monitoring site)		**3/10**	**3/10**	**3/10**	**5/10**
			>25%-50% of Benchmark	>25%-50% of Benchmark	>25%-50% of Benchmark	>5-25% of Benchmark
Native grass cover	Note the extent/occurrence pf native grass species		**1/5**	**1/5**	**3/5**	**5/5**
			>10-50% of Benchmark	>10-50% of Benchmark	>50-90% of Benchmark	>90% of Benchmark

Organic litter	Note the extent/occurrence of organic litter (percentage coverage within the monitoring site)		**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark	**5/5** >50%-<200% of Benchmark
Quality and availability of food and habitat required for foraging			**35/80**	**45/80**	**45/80**	**60/80**
Quality and availability of habitat required for shelter and breeding			**0/20**	**0/20**	**0/20**	**0/20**
	Site Condition Score (out of 190)	**79.6 (Baseline)**	**79.5**	**79.5**	**107**	**128**
	Site Condition Score (converted out of 4)	**1.67 (Baseline)**	**1.67**	**1.67**	**2.25**	**2.69**
Site Context						
Size of Patch		10/10	10/10	10/10	10/10	10/10
Connectedness		2/5	2/5	2/5	2/5	2/5
Context		4/5	4/5	4/5	4/5	4/5
Ecological Corridors		4/6	4/6	4/6	4/6	4/6
Role of Site location to species overall population in the state		2/15	2/15	2/15	7/15	12/15
Threats to Species		0/15	0/15	0/15	0/15	0/15
Quality and availability of habitat required for mobility		10/10	10/10	10/10	10/10	10/10
	Site Context Score (out of 96)	32	32	32	37	42
	Site Context Score (converted out of 3)	**1**	**1**	**1**	**1.15**	**1.31**
Species Stocking Rate						
Presence detected on or adjoining site		5/10	5/10	5/10	10/10	10/10
Species Usage (Habitat type & evidence of usage)		10/15	10/15	10/15	10/15	10/15
Approximate Density		10/30	10/30	10/30	20/30	20/30
Role/Importance of Species Population on Site		5/15	5/15	5/15	5/15	5/15
	Species Stocking Rate (out of 70)	30	30	30	45	45
	Species Stocking Rate (converted out of 3)	**1.29**	**1.29**	**1.29**	**1.93**	**1.93**
	Total Habitat Quality Score (out of 10)	**3.8 * AU Weighting Factor of 0.84 (3.8*0.84 = 3.19 (Actual MHQA Score)**	**3.96 Averaged Scores for AUs Round to 4**	**3.96 Averaged Scores for AUs Round to 4**	**5.33 Averaged Scores for AUs Round to 5**	**5.93 Averaged Scores for AUs Round to 6**

Table 13: Overarching Triggers, Corrective Actions and Timing to Achieve KPIs

Triggers	Corrective Actions	Timeframes
Trees and plantings showing signs of ill health, decline or death.	The restoration contractor will engage a suitably qualified professional to identify the likely cause of health decline Apply recommended mitigation measure/s to improve growing conditions (as recommended by the suitably qualified professional) Remove ill or dead plantings, undertake any remediation works and re-establishment planting	Engage the suitably qualified professional within three months of detection Implement recommended mitigation measures within six months of detection Remove ill or dead plantings and undertake remediation works within six months of detection
Weed re-establishment	Immediately treat all WoNs & BA weeds with delicate methods to avoid impacts to restoration works (mechanically or chemically dependent on circumstances) Undertake an investigation of the potential source point of seeding Additional treatment and removal works are to be followed up during the next potential growth period to avoid any regeneration and potential seeding events	Within three months of detection, noting that treatment during non-growth periods may be ineffective and are best targeted during growth periods for greater effectiveness Within three months of detection Within six months of initial detection
Plant failure (>10% of stock) during the establishment period	Supplementary planting will be undertaken Should the planting fail again, the contractor is to engage a suitably qualified professional to identify the likely cause of plant failure Apply recommended mitigation measure/s to improve growing conditions (as recommended by the suitably qualified professional)	Within six months or the next appropriate planting period (whichever comes first) of detection Within month of detection Apply in alignment with the recommendations made by the suitably qualified professional
Coarse woody debris is failing to become present naturally	The selective removal of limbs, shrubs, or trees (particularly from the shrub layer were forming dense thickets) Importation of felled native timber from known impact areas where it would ordinarily be mulched and sent to land fill	At the 5, 10, 15 and 20 year monitoring events At the 5, 10, 15 and 20 year monitoring events
Growth rates not as expected	Engage a suitably qualified professional to review the plantings and advise on methods to increase growth rates through other interventions Undertake soil testing to determine what rate of soil ameliorants or fertilizers may be required to improve the chemical balance of the soils for improved plant growth Revise management actions for offset Discuss with the Department to negotiate changes to timeframes to meet the completion criteria Revise OAMP and submit to Minister for the Environment for approval	Within three months of detection Within three months of detection Within 12 months of detection Within 24 months of detection if the corrective actions have not amended the slowing growth rates Within 24 months of detection if the corrective actions have not amended the slowing growth rates
Stochastic or nuisance events	While such events (eg. fire, flood, drought, vandalism etc) are rare and can be managed by the contractor, where events take place, restoration works are to replace losses and reporting to the DCCEEW is required Evidence of impacts and rectification measures are to be issued to the DCCEEW within three months	Within six months of the event Within six months of rectification
Ongoing presence of pest fauna (eg. wild dogs/pigs)	Where recurrent pest animal species are detected, reengagement with the surrounding landholders and ICC to re-deploy management measures. Should recurrent pest fauna be observed going forward, revised management measures to include more site-specific measures including targeted baiting and/or trapping	Within three months of continued presence identification
Monitoring and reporting illustrates that KPIs are unlikely to be achieved at the end of the 20 year management timeframe and other corrective actions are failing to progress the achievement of the KPI	Engage a suitably qualified professional to review the plantings and advise on methods to increase growth rates through other interventions Undertake soil testing to determine what rate of soil ameliorants or fertilizers may be required to improve the chemical balance of the soils for improved plant growth The proponent / approval holder will request an extension to the 20 year management timeframe from the Minister Revise the management actions for the offset Extend timeframes to meet completion criteria	Within three months of detection Within three months of detection Within 24 months of detection if corrective actions have not amended the slowing growth rates Within 24 months of detection if corrective actions have not amended the slowing growth rates Within 24 months of detection if corrective actions have not amended the slowing growth rates

Attachment 1:

Melaleuca irbyana Translocation Plan

Swamp Tea-tree (*Melaleuca irbyana*) Translocation Plan, North Maclean Industrial Estate Project, Greater Flagstone Urban Development Area

Prepared for:

28º S Environmental and Maclean Estates

Prepared by:

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6/3/2023

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Melaleuca irbyana (Swamp Tea-tree) Translocation Plan

About the Author: Dr Andrew Benwell is the Director of Ecos Environmental Pty Ltd, an environmental consultancy providing services in flora and fauna management, including field survey and assessment, management plans, translocation of threatened species, habitat restoration and specialist research. Ecos Environmental has translocated more than 40 plant species from all types of habitat over the last 20 years for state and local governments, and private enterprise in NSW and Qld, including successful translocation of *Melaleuca irbyana* for the Woolgoolga to Ballina upgrade of the Pacific Highway, as described below. Andrew is a co-author of the Australian Network for Plant Conservation (ANPC) Guidelines for Translocation of Threatened Plants in Australia (2018).

Summary

1.1 Project title

Swamp Tea-tree (*Melaleuca irbyana*) Translocation Plan for the North Maclean Industrial Estate, Greater Flagstone Urban Development Area

1.2 Project team

Dr Andrew Benwell

1.3 Contact details

andrewbenwell@bigpond.com; mob – 0487050005

1.4 Species name and conservation status

Melaleuca irbyana (Swamp Tea-tree/Weeping Paperbark/Bushhouse Paperbark/Small-leaved Paperbark) is listed as an Endangered species under the Qld *Nature Conservation (Protected Plants Regulation) 2020*.

Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland is listed as a Threatened Ecological Community (TEC) under the *Commonwealth Environmental Planning and Biodiversity Conservation Act 1999* (EPBC Act).

1.5 Nature of translocation

The translocation set out in this plan is a mitigation translocation using propagation and introduction with the aim of establishing plantings of *M. irbyana* to compensate for individuals cleared on the development footprint and thereby prevent further decline in population and genetic diversity. In redressing loss of *M. irbyana* individuals, the translocation will at the same time create a substantial new stand of *M. irbyana* equivalent to the TEC *Swamp Tea-tree (Melaleuca irbyana) Forest of South-east Queensland* and conduct research into the species' ecology.

1.6 Background information

Swamp Tea-tree is small to medium sized tree up to about 10 m high with light grey, coarse, papery bark and branchlets of very small leaves (2-3 mm), which in larger trees is often dense and weeping. It occurs mainly on poorly drained, heavy clay soil on flat to gently

sloping terrain in eucalypt woodland, or as a monospecific closed forest. Its habitat has been extensively cleared for agriculture, reducing it to less than 10% of its original population.

1.7 Justification

Benefits of translocating Swamp Tea-tree include: (i) compensate for the loss of approximately 90 mature and 5 immature trees on the development site; (ii) maintain or increase present population number and prevent further regional decline; (iii) increase the area of Swamp Tea-tree Threatened Ecological Community; and (iv) improve understanding of species ecology and appropriate translocation methods.

1.8 Stakeholder consultation

Maclean Estates (Brad Hanson)

28º S Environmental (Wayne Moffitt)

1.9 Other approvals/authorities

Protected Plant Clearing Permit (Department of Environment and Science Qld)

1.10 Risk assessment

General risks, their likelihood and counter measures are as follows:

Risk	**Likelihood**	**Counter measures**
Translocation methods poorly executed resulting in low survival rates.	Low to medium.	Supervision; clear guidelines, experienced personnel.
Translocation project fails to meet performance criteria.	Low to medium	Adequate resourcing and managerial oversight.
Maintenance and/or monitoring not carried out as specified in plan.	Low to medium	Clear workplan and goals.
Measures not implemented to ensure long-term conservation of the Recipient Site.	Low	Set time limit for completion.

1 Introduction

1.1 Background

Ecos Environmental has been engaged by 28º S Environmental to prepare a Translocation Plan for the threatened species *Melaleuca irbyana* (Swamp Tea-tree) in relation to a proposed industrial estate development at 4653-4691 Mt Lindsay Highway, North Maclean, 30 km southwest of Brisbane. The development footprint covering approximately 19.68 ha is proposed for expansion of an industrial precinct currently being constructed adjoining the northern boundary of the site.

The western portion of the site is to be retained as conservation area and to protect an area of *M. irbyana* Threatened Ecological Community. The 'Subject Site' herein refers specifically to the development footprint of the industrial estate within the eastern section of the site boundary (Figure 1).

Swamp Tea-tree (*Melaleuca irbyana*) is listed as an Endangered species under the Qld *Nature Conservation (Protected Plants Regulation) 2020*. The plant community 'Swamp Tea-tree (*Melaleuca irbyana*) Forest of South-east Queensland', which is a distinct ecological community dominated by *M. irbyana*, is also listed under the Commonwealth *Environmental Planning and Biodiversity Conservation Act 1999* (EPBC Act) as a Threatened Ecological Community (TEC).

The Subject Site is governed by the Qld Department of State Development, Infrastructure, Local Government and Planning/Economic Development Queensland, according to the *Greater Flagstone Urban Development Area Interim Landuse Plan* (Qld Gov. 2011), which identifies the Subject Site as a part of a Proposed Urban Development Area and Major Employment Area. The Subject Site is currently zoned as part of an industrial precinct within the Greater Flagstone Priority Development Area (PDA) (Qld Gov 2011).

A Protected Plant Clearing Permit will the submitted to the Department of Environment and Science Qld in conjunction with this Translocation Plan

1.2 Surveys completed

A flora survey of the Subject Site was carried out by 28°S Environmental in April 2022, including mapping of *Melaleuca irbyana* individuals. Due to the coppicing habitat of this species, there was uncertainty regarding the size of the population as it was possible multi-stemmed individuals were clonal in origin and represented fewer genetic individuals. An additional survey and census of *M. irbyana* on the Subject Site was carried out by Ecos Environmental in November 2022 to assess trees for morphological evidence of clonality (i.e. root suckering) and record the number and size of impacted individuals.

An Offset Site on the Rosewood-Laidley Road was also surveyed by Ecos Environmental to assess if the property was suitable as a recipient site for translocating *M. irbyana* in terms of vegetation, soil, topography and logistical considerations.

Plate 1: *Melaleuca irbyana* (Swamp Tea-tree, Small-leaved Paperbark, Bush-house Tea-tree). From top clockwise - branchlet showing very small leaves (3mm long); branchlet with woody capsules forming after flowering; remnant trees near Rosewood with *E. moluccana* (Grey Box) and *Acacia harpophylla* (Brigalow) in the background.

1.3 Content of this report

This Translocation Plan for *Melaleuca irbyana* has been developed to provide the following:

- Description of the Project
- Description of the impacts to *Melaleuca irbyana*
- A Translocation Plan, which includes:
  - Pre-translocation assessment
  - Translocation strategy
  - Translocation methods and actions
  - Post-translocation actions
  - Translocation objectives, outcomes, and performance requirements

The content of this Translocation Plan generally follows the format proposed in ANPC (2018), *Guidelines for Translocation of Threatened Plants in Australia* (co-authored by Dr Benwell). The Logan City Recovery Plan for *Melaleuca irbyana* (2013-2023) was also consulted in preparing this plan.

1.4 Definition of terms/glossary

Table 1: below provides definitions of various technical terms used in the translocation plan

Technical term	Definition
Clonal	Group of plants arising by vegetative reproduction and therefore genetically identical.
Coppiced tree	A coppiced tree is a multi-stemmed individual with stems joining at or near ground level. (A copse is a thicket of stems)
Compensatory introduction	Mitigative translocation approach designed to redress loss of individuals on a development
Donor or source population	The population that plants to be translocated are sourced from, which is usually the local population (see above), including plants impacted by a development.
Dry sclerophyll forest	Broad vegetation type characterised by an upper stratum of *Eucalyptus* and an understorey dominated by grasses and/or sclerophyllous shrubs.
Enhancement	An attempt to increase population size (and genetic diversity) by adding to individuals to an existing population. Also referred to as re-enforcement, re-stocking, enrichment, supplementation or augmentation.
Footprint	Area within the project boundary cleared and disturbed during highway construction.
Genet	Individual plant originating by sexual reproduction (ie. chromosome recombination), which is genetically different from other plants of the same species. Genets grow from seed produced by the parent plant.

Genetic variability	Variation in the genetic composition among individuals and populations.
Inbreeding	The mating of individuals related by descent, usually causing a reduction in gene heterozygosity and diversity.
Inbreeding depression	A reduction in vigour and fitness due to inbreeding.
In-situ	The original place; pertaining to the maintenance of plants in the wild.
Local population	An assemblage of individuals belonging to the same species in this instance within 2 km of the CHB project boundary, found in the same type of habitat (soil type and vegetation).
Population	In a general sense, a group of individuals sharing some common relationship (e.g. spatial, genetic, morphological). In one sense, a group of individuals in which there is free breeding and gene exchange. Populations can defined at any geographic scale from very local to regional, depending on purpose.
Propagation	A translocation technique or approach where plants are propagated (e.g. seed, cuttings, tissue culture) under nursery conditions then introduced to a site.
Provenance	A genetically distinct area of a species distribution and usually thought to represent genetic adaptation to local environmental conditions.
Ramet	Individual plant originating by asexual reproduction (i.e. via vegetatively) which is genetically identical to other plants of the same species.
Reintroduction	An attempt to establish a population in a site where it formerly occurred, but where it is now extinct. Also, referred to as re-establishment
Road reserve	Land within a highway boundary or within the project boundary that is not part of the construction footprint.
Root sucker	A stem sprout arising from an existing underground root
Salvage transplanting	Transplanting off the footprint to an area not affected by the development. Also referred to as rescue dig.
Self-sustaining	A population of plants that maintains itself without external assistance.
Threatened species	Plant taxa in danger of extinction and protected by state or federal environmental legislation.
Threatened species point	GPS record or positional coordinates of a threatened species individual or closely spaced group of individuals.
Translocation	Translocation is defined as the "deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where the taxon is now extinct" (ANPC 2018) or “the intentional movement or introduction of plant material to a natural or managed area with the aim of establishing a resilient, self-sustaining population to increase geographic range, population size and/or genetic diversity, thus reducing risk of extinction (IUCNSSC 2013)”.

2 Nature of impacts

2.1 Direct impacts

Survey and census found that 95 *M. irbyana* individuals would be impacted by clearing of the Subject Site (Figure 1), the majority being large, coppiced or multi-trunked trees. Three trees are next to the Mt Lindsay Highway in a strip required for highway widening.

M. irbyana is protected under legislation as an endangered species (Qld NC Act) and as a threatened ecological community (Commonwealth EPBC Act) if it forms the dominant canopy species. The former situation where *M.irbyana* is present as single trees or small groups of trees in eucalypt dominated woodland, rather than forming a distinct plant community, applies to the Subject Site.

2.2 Local and regional occurrence of *M. irbyana*

The total distribution of *M. irbyana* is divided into three distinct metapopulations separated by barriers of unsuitable geology and soil type: southeast Qld south of the Brisbane River; the Carnarvon district in Central Queensland; and the Grafton district on the NSW North Coast.

The southeast Qld metapopulation occurs in a band across the Logan and Ipswich City Council areas, from Logan to Gatton south to Jimboomba and Laidley, on flat to gently undulating topography. *M. irbyana's* habitat in this area was extensively cleared for agriculture and remaining habitat areas are mostly grazed by cattle. Today, *M. irbyana* is restricted to small patches in remnant vegetation, often forming stands of the TEC.

The Subject Site is located on the Mt Lindsay Highway between Logan and Jimboomba in the southeast Qld metapopulation. A substantial number *M. irbyana* occurrences are recorded in this area, extending west for 30 km to the Rosewood district where the Recipient Site is located (Figure 2). A stand of *M. irbyana* TEC is located within the site boundary southwest of the Subject Site and is excluded from development footprint in a protected conservation zone (28º S 2022).

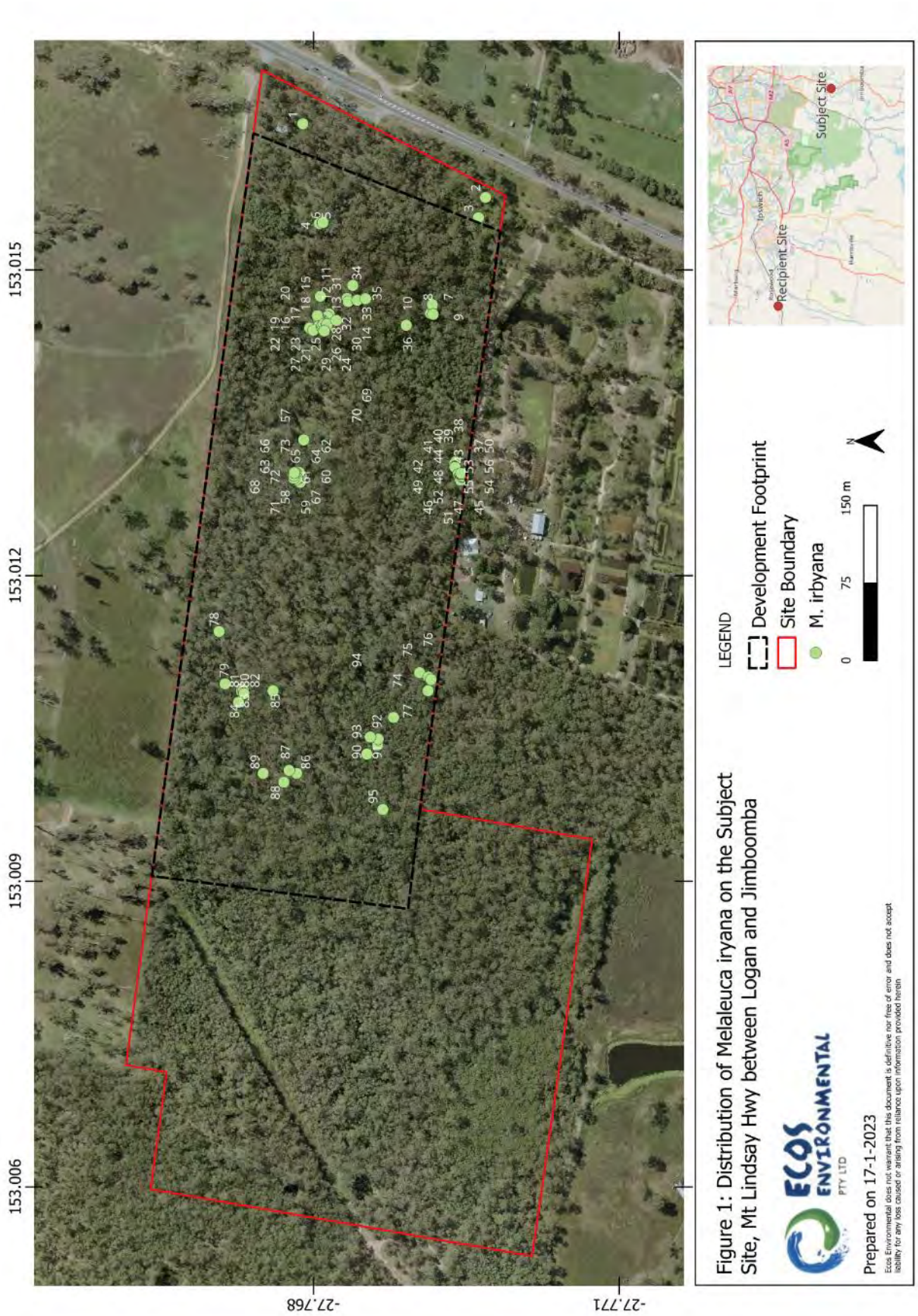

Figure 1: Distribution of Melaleuca iryana on the Subject Site, Mt Lindsay Hwy between Logan and Jimboomba

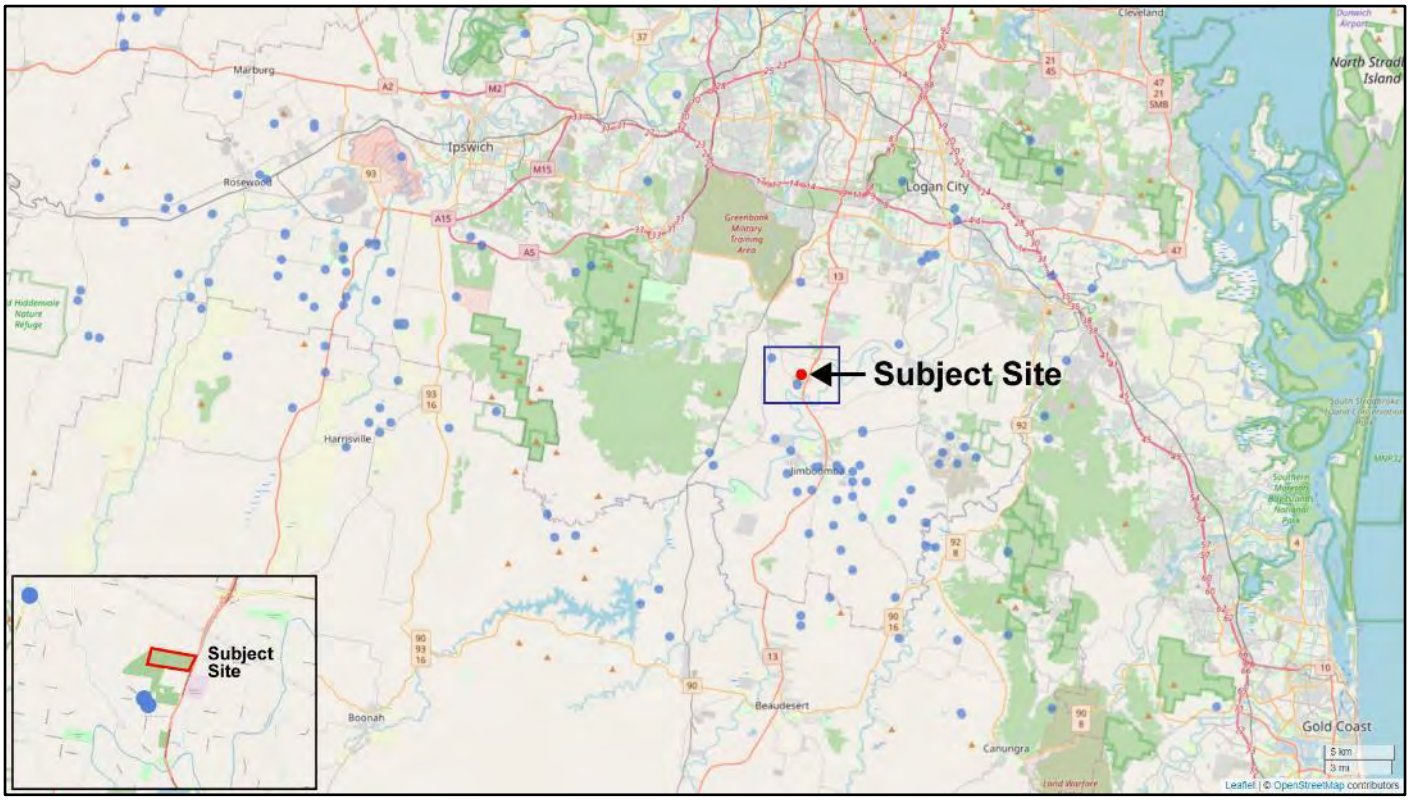

Figure 2: Locations of *Melaleuca irbyana* recorded in Atlas of Living Australia (blue dots) in a band between Logan and Gatton south of the Brisbane River. The Subject Site is indicated by the red dot and inset.

3 Translocation Strategy

3.1 Translocation Objectives

The purpose of translocating threatened plant species in a developmental context is to minimise loss of population number and genetic variability due to clearing or indirect impacts. The over-arching objective is to establish a self-sustaining population over the long term (ANPC 2018).

The general objectives of this Translocation Plan are as follows: -

- To compensate for loss of *Melaleuca irbyana* trees on the development footprint and enhance the local and regional population of *Melaleuca irbyana* by establishing a new stand of Swamp Tea-tree (*Melaleuca irbyana*) Threatened Ecological Community (TEC) at a Recipient Site containing suitable habitat for the species in terms of vegetation (actual or potential), soil type and topography.
- To utilise seed of *Melaleuca irbyana* from the development footprint to propagate plants for introduction to the recipient site.

- To conserve genetic variability by propagating from trees across the development site.
- To factor in thinning of introduced plants over time due to environmental stress, competition, genetic variability and other factors.
- To promote long-term population sustainability by restoring and maintaining good quality habitat for the species.
- To improve understanding of species ecology and translocation methods by adopting an experimental approach to translocation where practical.

3.2 Type of translocation

Translocation is defined as the "deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where the taxon is now extinct" (ANPC 2018). Translocation of threatened plants can be carried out in two main contexts:

- **Conservation purposes** – being a conservation measure to assist in the recovery of threatened or rare species.
- **Developmental translocation** – being a mitigation measure to ameliorate the adverse impact on a threatened species due to a development activity.

Translocation in both these cases has the same general purpose, which is to avoid losing populations of threatened species and decrease the risk of population extinction (Pavlik 1996).

In translocation for conservation purposes, the following three types of translocations are described in ANPC (2018):

- **Enhancement:**
  - An attempt to increase population size or genetic diversity by adding individuals to an existing population. This may be part of a process of rehabilitation of a site where the taxon already occurs but requires augmentation to increase long-term viability. Also referred to as re-enforcement, re-stocking and enrichment.
- **Reintroduction:**
  - An attempt to establish a population in a site where it formerly occurred, but where it is now extinct. This may be part of a process of restoration of a habitat where the taxon was previously known to occur. Also, referred to as re-establishment.
- **Conservation introduction:**
  - An attempt to establish a taxon for the purposes of conservation at a site where it is not known to have occurred, but which provides suitable habitat for the taxon.

Under Developmental Translocation, the following three types of translocations may apply (ANPC 2018):

- **Salvage dig:**

- Transplanting of individual trees, saplings or other plants to an area not affected by development. Salvage or rescue digs should only be carried out as a last resort after options for avoidance are exhausted and is generally combined with other translocation methods.

- **Ameliorative enhancement:**
  - An attempt to increase population number by adding individuals to an existing population for purposes of ameliorating loss of population due to development.
- **Compensatory introduction:**
  - Establishment of a new population to compensate for loss of population due to development.

The translocation proposed for *M. irbyana* in this plan combines elements of **enhancement** and **compensatory introduction** as defined above. It proposes to establish a new stand of Swamp Tea-tree (*Melaleuca irbyana*) Threatened Ecological Community (TEC) to compensate for loss of *Melaleuca irbyana* trees on the development footprint and enhance the regional population of *Melaleuca irbyana*. A research component has been included in accordance with ANPC (2018) guidelines that recommend including relevant scientific research on species ecology and translocation techniques as part of threatened flora translocation projects.

As translocation is a relatively new field of biodiversity management, guidelines such as ANPC (2018) recommend incorporating experiment design and research into threatened flora translocations with the aim of advancing understanding of species ecology and translocation methods, as well as aiming to maintain and increase population by enhancement and compensatory actions. A research proposal has been designed as part of the translocation plan, although this should be considered separately from the population enhancement and compensatory measures.

3.3 Previous translocation of *Melaleuca irbyana*

Melaleuca irbyana was translocated during the Woolgoolga to Ballina upgrade of the Pacific Highway (2014-2018) on the NSW North Coast, as a mitigation measure for clearing part of a population at New Italy, south of Ballina. The translocation was carried out by propagating seed collected from the clearing footprint. Tubestock were planted in three Recipient Sites at Tabbimoble Creek 20 km south of the impact site in July 2017. To assess how fertiliser affected performance, fertiliser and no fertiliser treatments were applied in two sub-plots. The plantings were given additional watering during drought conditions and maintenance carried out to reduce competition from native tree saplings and exotic grasses (Ecos Environmental (2022).

High survival rates and relatively fast growth rates were achieved after three years.

Average height of seedlings (cm) over three years:

	no Fertiliser	Fertiliser
Mar-2017	31.4	42.3

Apr-2018	68.9	109.3
Jul-2019	108.9	211.0

All three receival sites were burnt by bushfire in Nov 2019, when *M. irbyana* plantings were approximately 3 years old and 1 – 2 m high. Fire intensity at the sites varied from low to high. Above ground stems were killed by fire and most plants regenerated by coppicing (resprouting) from the stem base and root crown just underground. Six months post-fire, plants were about half their pre-fire height and after 2 years slightly less than height before fire. In November 2021 there were approximately 600 plants in the three sites, which covered approximately 2 ha.

3.4 General approach

Translocation of threatened plant species in a development context is usually carried out by either salvage transplanting or propagation. The latter approach was preferable for this project due to: (i) high cost involved in transplanting a large number of fairly large trees; (ii) previous low survival rate after transplanting trees into heavy clay soil (due to waterlogging increased by soil disturbance); and (iii) demonstrated success of translocation of this species by propagation and planting.

This Translocation Plan proposes to establish a new area of the TEC at the same time as compensating for loss of trees and habitat on the development footprint. A monospecific stand of *M. irbyana* will be planted on a section of the recipient site with a soil profile similar to reference areas of the TEC.

Soil surveys found the Offset Site also to be used as a Recipient Site for translocation of *M. irbyana* contains different soil types, including a Vertosol or black, cracking clay similar to reference areas with natural stands of the TEC (see Appendix 2). Most of the propagated *M. irbyana* will be planted into a cleared area of this soil type that presently supports pasture. Smaller plantings are proposed to compare growth and establishment on different soil types within the recipient site.

3.5 Propagation of impacted *M. irbyana* via seed collection

A total of 3600 *Melaleuca irbyana* will be propagated from seed collected from the Subject Site, as follows:

- Seed capsules will be collected prior to vegetation clearing.
- To capture genetic diversity present in the Subject Site population, seed capsules will be collected from a minimum of 10 swale and 10 rise trees of *M. irbyana* at points spread out between the eastern and western ends of the Subject Site (see Appendix 1).

- Roughly equal amounts of seed will be collected from each tree and placed in sealable plastic bags labelled with the tree number and whether swale or rise.
- The seed capsules will open in the plastic bags in a few days (if sweating occurs, partly seal bag and stand up in a container).
- Seed from swale trees will be bulked together and the same for the rise trees, keeping some of the seed in the original labelled bags.
- Seed from the swale and rise trees will be germinated in separate trays labelled with swale or rise provenance.
- Equal numbers of swale and rise seedlings will be pricked out and grown-on in native tubes in separate labelled trays.
- Propagation will be carried out by a translocation specialist or nursery experienced with propagating plants for translocation projects.
- Tubestock will be grown-on for 12 months and be well hardened off before planting.

Inspection of trees during the census survey indicated low quantities of seed capsules on trees, but enough to carry out propagation.

3.6 Translocation feasibility

Previous results with this species indicate that translocation by seed propagation and planting has a high probability of success.

3.7 Translocation benefits and risks

Translocation benefits

Translocation of *Melaleuca irbyana* by propagation and planting is anticipated to have the following benefits:

- Ensuring the Project has no-net loss of plant species of high conservation value/priority.
- Translocation of the species is technically feasible as successful propagation and planting of the species has previously been undertaken (Ecos Environmental 2022).
- Suitable Recipient Sites have been identified and are available for planting.
- The translocation and propagation will maintain the genetic diversity of the population.

- The propagation and planting will potentially increase the local population and assist with the conservation of the species.
- The opportunity to better understand the ecology of the species by incorporating experimental treatments into the plan.

Translocation risks

The main risks associated with translocation is that the translocated individuals fail to establish over the short to long-term due to various factors such as extended periods of soil waterlogging or drought, grazing by insects or mammals, and plant disease, all of which are considered unlikely and manageable risks.

Myrtle Rust can affect seedlings of Melaleuca species, particularly when grown in a humid hothouse environment with misters and little ventilation. If grown in an open-air shade house with sprinklers, Myrtle Rust is unlikely to be a problem.

3.8 Research

To incorporate a research component as recommended in the Translocation Guidelines (ANPC 2018), experimental plots will be established in the four Planting Areas to compare the growth of *M. irbyana* propagated from swale and rise provenances in the four planting areas on differing soil types. The aim will be to determine if the two localized (putative) provenances are genetically differentiated by comparing growth on a common site, which will be carried out in the four Planting Areas.

Research will examine the following questions to inform understanding of species ecology and translocation techniques:

- Are *Melaleuca irbyana* populations genetically differentiated by local variation in soil type?
- Is the performance of *M. irbyana* plants affected by differences in soil type provenance of collected seed ?

See also Sect. 7.7.4.

4 Pre-translocation assessment

4.1 Habitat requirements

M. irbyana occurs in low elevation, flat to gently undulating terrain on poorly drained, clay textured soils (sometimes with a more porous silty topsoil), on deeply weathered Clarence-Morton Basin sediments or old alluvium. It can grow as scattered trees and clumps of trees in open eucalypt woodland, or as a dense, monospecific stand. Associated trees include *E. tereticornis, E. moluccana, E. crebra, E. melanophloia, Corymbia leiocarpa, C. tesselaris* and *Acacia harpophylla* (Brigalow). The understorey consists of grasses, sedges and herbs with few shrubs and vines. Pure stands appear to be confined to flats on poorly draining, heavy clay soils. These sites are not very swampy as its common name suggests, although soil becomes saturated during the rainy season and the sub-soil is a poorly drained dense clay. Pure stands on flats are on slightly higher ground than Broad-leaved Paperbark (*M. quinquenervia*) swamp forest. *M. irbyana* can also occur on gently undulating terrain with silty loam topsoil and heavy clay subsoil (Aust. Gov. and Qld threatened species profiles).

4.2 Fire ecology

In a population of *M. irbyana* at New Italy south of Ballina burnt in the 2019 bushfires, *M. irbyana* trees regenerated by epicormic and basal resprouting, and recruited seedlings from seed released from fire-resistant seed capsules. After three years, seedlings were over one metre high in a more open section of the site and had developed small lignotubers. At this location, *M. irbyana* occurs as a mid-stratum tree in grassy dry sclerophyll forest dominated by Large-leaved Spotted Gum (*E. henryii*), on heavy clay soil. See also Section 3.3.

4.3 Genetics

A genetic study of *Melaleuca irbyana* across its whole range extending from Central Qld to the Grafton district in NSW was carried out by Burrough *et al.* (2018). They investigated how genetic diversity was distributed in the species and if there was any evidence of populations being inbred or clonal.

They found genetic diversity was lowest at the southern end of its range. highest in the north and relatively high overall. Most of the genetic diversity (66%) was within populations and there was significant diversity between populations. Gene flow between populations appeared to be low to allow genetic divergence. A deficiency of heterozygotes was present in all populations indicating inbreeding, but this was not significantly correlated with patch size or isolation. There was no evidence of clonality as “all multi-locus genotypes were unique in every population”.

Broadhurst *et al.* (2017) found that *M. irbyana* had a low level of genetic diversity for an often-localized species, but Burrough *et al.* (2018) found it was relatively high for an endangered species and that *M. irbyana* displays genetic diversity similar to a wide range of *Eucalyptus* species, a similar level of diversity to the widespread *Melaleuca quinquenervia* and higher genetic diversity than *M. alternifolia*, the commercial tea-tree oil species. They

commented, it is likely that species only recently size constrained (i.e reduced to isolated populations) maintain diversity by self-compatibility. Ability to resprout apparently slows the loss of genetic diversity.

Overall, these studies indicated that all populations of *M. irbyana* are likely to contain significant genetic diversity. If the aim of translocation is to maintain genetic diversity, this can be achieved by propagating from seed taken from individuals across the impacted population rather than from a few selected trees. Propagated plants from the Subject Site would not be interplanted with existing trees at the Offset Site. However, establishing a translocated population near an existing in-situ population is unlikely to have any adverse effect on genetic fitness, rather it may promote genetic mixing and increase genetic diversity.

4.4 Description of impacted population

4.2.1 Topography and soil

The Subject Site is on gently undulating topography of flats and gradual rises. Soil cores taken from flats and rises had differing soil profiles. Rises had pale, grey-brown, silty textured A1 horizon; slightly paler A2 horizon; and clay textured B horizon. On the flat, the AI horizon was slightly darker with higher organic matter and graded into a dense, clay pug subsoil. The soil profiles from swales and rises were similar in having a dense, clay subsoil.

4.2.2 Vegetation

M. irbyana grows on the Subject Site as small clumps of trees and scattered individuals in Communities 1 and 2 described in Table 2. Community 1 occurs on slight topographic rises and has a wider range of canopy trees species of *Eucalyptus* and *Corymbia*. Community 2 on flats and swales between the rises has a higher percentage of Swamp Box (*Lophostemon suaveolens*) and Qld Blue Gum (*E. tereticornis*) and differences in soil profile (Appendix 2, although with the same, dense clay subsoil. *M. irbyana* appears to tolerate some variation in vegetation and soil type.

Table 2: Plant communities found on the Subject Site (source: 28º S Environmental (2022).

Plant communities and equivalent regional ecosystems	**Terrain/*M. irbyana* present or absent**
Vegetation Community 1 – Coastal grey box (*Eucalyptus molucanna*) and Narrow-leaved ironbark (*Eucalyptus crebra*) +/- Pink bloodwood (*Corymbia intermedia*), Smooth-barked apple (*Angophora leiocarpa*) and Narrow-leaved red gum (*Eucalyptus seeana*). Comprises a mosaic of REs.	On slightly elevated rises occupying eastern and central section of site. *M. irbyana* present as scattered clumps and single individuals.
Vegetation Community 2 – Coastal grey box (*Eucalyptus moluccana*), Narrow- leaved red	Occurs in an overland flow path inn the eastern side of the site. The canopy is

ironbark (*Eucalyptus crebra*) +/- Queensland blue gum (*Eucalyptus tereticornis*). Equivalent to RE 12.3.19.	dominated by Coastal grey box and Narrow-leaved red ironbark. There is scattered occurrence of Queensland blue gum (*Eucalyptus tereticornis*). *M. irbyana* present as scattered clumps and single individuals.
Community 3 – Broad-leaved paperbark (*Melaleuca quinquenervia*) open forest. This community is analogous to RE 12.3.5 rather than the mapped RE 12.3.18.	Narrow, low-lying zone on western edge of site. *M.irbyana* absent (too low lying).

An aerial photograph taken in 1948 shows the Subject Site completely cleared apart from a low-lying section at the western end of the of the site that supports Broad-leaved Paperbark (*M. quinquenervia*) swamp forest today. Photography from 1962 shows a similar extent of clearing and the Swamp Tea-tree (*Melaleuca irbyana*) community directly southwest outside the Subject Site. Some regeneration is evident in the 1973 photography, but the eastern parts of the Subject Site remain disturbed and by 1990, regrowth has become more advanced in the eastern part of the Subject Site, vegetation in the west remains intact, and adjoining areas are recovering. Today, after approximately 50 years of regrowth, most of the forest has reached a young mature stage, yet to form late mature characteristics such as presence of hollow-bearing trees.

4.2.3 Population size, structure, and life history

The census survey recorded a total population of 95 *Melaleuca irbyan*a on the Subject Site, mainly in discrete groups that can be seen on Figure 1 (see Appendix 1 for details of height, girth and number of coppice stems per individual). Nearly all trees were relatively large and there was no cohort of young trees or saplings (Figure 3). This is probably because the site has not been burnt for several decades, recruitment most likely occurring after fire when seed is released from seed capsules into an ash bed on fire-sterilised surface soil.

M. irbyana can be single-trunked, or coppiced (multi-stemmed) with trunks joining together at or near ground level. Coppiced trees are multi-trunked individuals. Genetic studies of *M. irbyana* found no evidence of clonality in *M. irbyana* populations, indicating that it does not reproduce from root suckers or produce clonal patches of trees. Fallen trees may produce roots from the trunk and regrow a new stem (EPBC listing advice), but this is a form of resprouting, not clonal reproduction. Individual trees whether coppiced or single-stemmed must ultimately come from seedling recruitment, although established plants can persist by resprouting if damaged by disturbances such as fire, drought and clearing. These life history characteristics are also seen in common *Melaleuca quinquenervia* (pers. obs.).

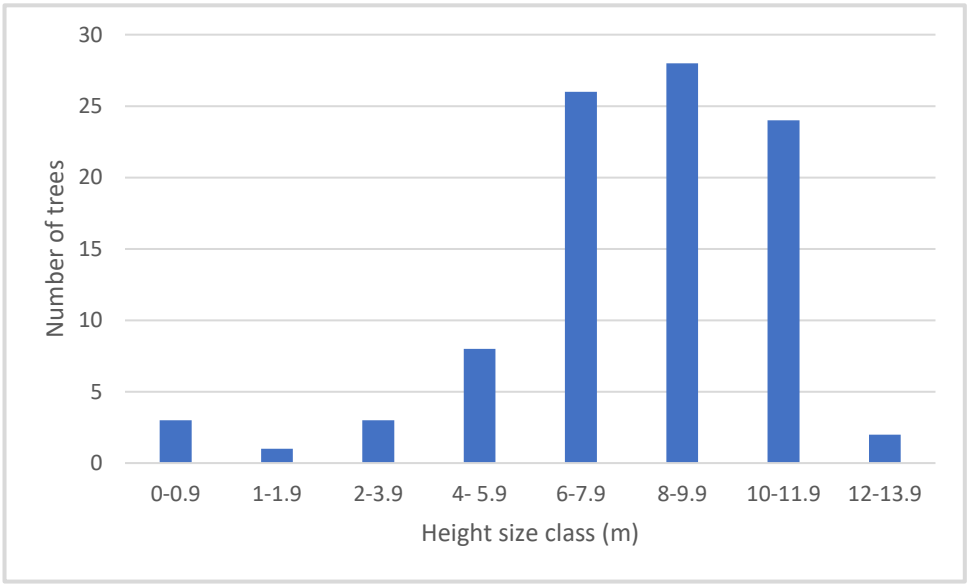

Figure 3: Size class distribution of *M. ibyana* on the development footprint by plant height.

4.5 Translocation recipient site

4.5.1 Location

The Recipient Site for translocation *M. irbyana* is on the project Offset Site located 5 km southwest of Rosewood on the Rosewood-Laidley Road (Figure 4).

4.5.2 Topography and Soil

The Offset Site is a flat to very gently sloping area adjoining hills on sedimentary geology to the south and includes some lower hill slope along its southwest boundary. Soil samples were collected from the footslope at the southwest corner of the recipient site and three points on the flat to north. The flat is a mixture of flat ground at slightly higher elevation (e.g 10-20 cm) and gilgai on slightly lower ground. The gilgai is poorly drained as indicated by greater abundance of sedges and Nardoo (*Marsilea mutica*). The black clay soil on slightly higher ground has been cropped in the past according to the owner and is better structured although still with a high clay content – see Appendix 2.

4.5.2 Vegetation

Approximately two-thirds of the recipient site is cleared pasture and one third regrowth woodland of *Eucalyptus tereticornis* (Qld Blue Gum), *E. crebra, E. siderophloia* and *E. melanophloia* (ironbarks)*, Angophora subvelutina, Angophora leiocarpa* and *Corymbia tesselaris* (Carbeen). Large, old Qld Blue Gum trees are scattered across the site. The southwestern end of the site on the footslopes of sedimentary hills to the southwest was strip-mined to a depth of about 1 m 30-40 years ago and is covered by widely spaced original trees on high points, which were mined around, and sapling regrowth on the mined

ground in between. Tree species are similar to the flat, with more *Angophora leiocarpa* and a wider variety of small trees including *Petalostigma pubescens* (Bitter Bark).

Remnant patches of *M. irbyana* occur on the flat at the southern end of the property near the Rosewood-Laidley Rd. The *M. irbyana* is fragmented into patches and single trees which is probably the result of partial clearing in the past. The trees are large with heights over 10 m and diameters up to 60 cm, so are probably original trees left for shade and ornamental value. Young trees were rare probably due to absence of fire and heavy trampling of the clay soil by cattle.

4.5.4 Planting areas

An area of previously cropped soil on the flat adjoining Rosewood-Laidley Rd covering approximately 2.8 ha has been selected as the main Planting Area for the *M. irbyana* translocation (Figure 4). This area in the southwest of the Offset Site is likely to have supported *M. irbyana* forest when the area was first settled, as remnant patches remain on poorer soil unsuitable for clearing. The soil type in the main Planting Area is very similar to reference sites with existing stands of *M. irbyana* forest, including Purga Nature Reserve (Appendix 2, Site R-L SS5 (Recipient Site) and Sites 9-10 (Reference Sites)).

The translocation plan aims to plant about 80% of propagated *M. irbyana* in Area 1 to establish a stand of *M. irbyana* forest or TEC. The other 20% will be planted in three smaller areas to establish nuclei from where *M. irbyana* may spread across the site as an understory component of eucalypt woodland, and for ecological research purposes.

The four planting areas in the Recipient Site shown on Figure 4 are as follows:.

Area 1 – main planting area, structured, black cracking clay (Vertisol)

Area 2 – slightly wetter than 1 (Vertisol/Hydrosol)

Area 3 – slightly wetter than 1 (Vertisol/Hydrosol)

Area 4 - silty loam (Kurosol) on footslope sedimentary colluvium.

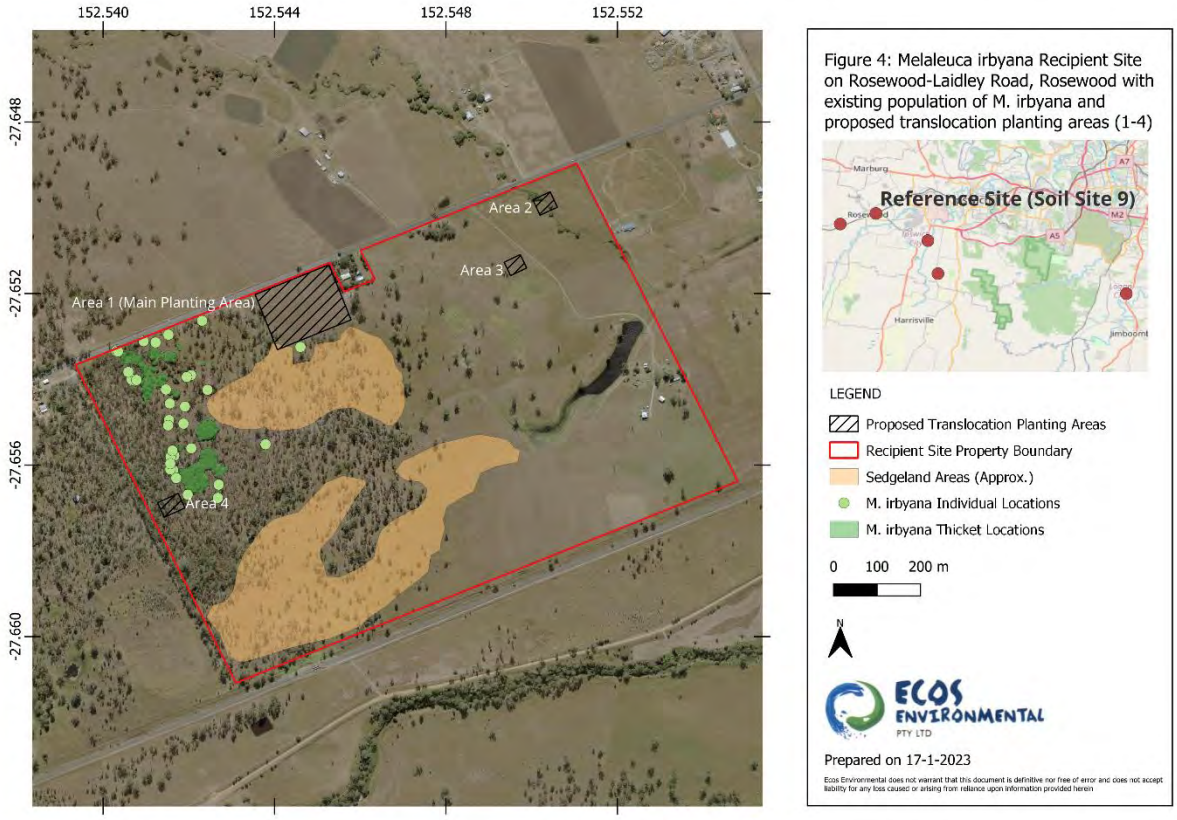

Figure 4: Melaleuca irbyana Recipient Site on Rosewood-Laidley Road, Rosewood with existing population of M. irbyana and proposed translocation planting areas (1-4)

4.5.5 Habitat restoration

The southwestern half of the Recipient Site is already covered by natural sapling to small tree regeneration, which can be seen on the aerial photograph (Figure 4). Establishing tubestock of eucalypts, angophora, Brigalow and other propagated species on poorly drained, heavy clay soil can be challenging, and it may be more effective to allow natural regeneration from remnant trees, as presently occurring across the site to continue, or be assisted by strategic burning of the site. Habitat restoration will be described in an Offset Site Management Plan.

As part of the Translocation Plan, habitat restoration plantings will be implemented in 20 m buffer around the Planting Areas (Section 7.2).

4.6 Reference sites

Three references sites with stands of *M. irbyana* TEC were surveyed during the soil study – Mill St, Rosewood; Warrill Park Lawn Cemetery; Purga Nature Reserve (Appendix 2). Vegetation floristic, structure and condition data will be recorded at the three sites when end-of-year/annual monitoring of the recipient site is conducted to allow for comparison of *in-situ* and translocated plants to determine the success of translocation in relation to underlying *in-situ* population trends.

5 Translocation actions – introduction of propagated plants

5.1 General

This section details measure involved in introduction of propagated plants, including:

- Preparation of the recipient site
- Planting of propagated individuals
- Completion of planting requirements

5.2 Preparation of the recipient site

5.2.1 Timing of planting

Planting will be carried out when the site is relatively dry to allow vehicle and machinery access. This will probably be between August and December but may be changed according to weather conditions. The Translocation Contractor is to determine the most appropriate time of year for planting. The following are to be considered when determining when to undertake the planting:

- Planting should be undertaken in consideration of seasonal rainfall patterns with a preference to when soil moisture is high.
- Planting should be avoided when there is a risk of soil waterlogging and flooding.
- Planting will not be undertaken during cold and dry conditions to avoid frost and minimise watering activity.

5.2.2 Survey and marking of Planting Areas

The corners of four Planting Areas within the Recipient Site will be pegged (e.g. zinc alum star picket painted white) and the coordinates recorded with a GPS. Each vertex/peg shall be marked to be clearly visible to allow for ease of visibility when preparing the Planting Areas and when undertaking future works and/or monitoring.

5.2.3 Weed control

Prior to the commencement of planting, pasture and weeds in a circle of radius 50 cm will be sprayed with herbicide and left for 2-3 weeks before planting. Patches with good quality native ground cover should be avoided. All weed management works shall be conducted by suitably experienced Revegetation Contractor or Bush Regenerator with appropriate native and weed species identification skills, under supervision of the Translocation specialist.

Only herbicides suitable for application adjacent to waterbodies (as detailed on the manufacturer's specifications) are to be used. Only frog friendly herbicides will be permitted to be used and herbicides are not to be used within 20 m of drainage lines and lagoons on the Offset Site.

Herbicide sprays should not be applied during rainy or high wind conditions to avoid affecting non-target species. All weed control works are to be conducted using best practise techniques. The handling and application of herbicides shall:

- Only be carried out by a Translocation Contractor or Bush Regenerator who possesses qualifications and licences relevant to the products being applied;
- Be in accordance with relevant legislation and policies;
- Be in accordance with the manufacturer's instructions; and
- Be applied with biodegradable, non-toxic tracer dye to highlight areas sprayed.

To minimise the potential to introduce and/or spread weeds and myrtle rust to the Planting Area, the following weed hygiene strategies are required:

- All vehicles and machinery are to be cleaned before entering the Recipient Site;
- Worker's clothing, shoes and other equipment are to be cleaned before entering the Recipient Site;
- Any soil, gravel or fill imported into the Recipient Site is to be declared weed free;

5.2.4 Planting set out

One main Planting Area and three smaller Planting Area's will be established in the Recipient Site (Figure 2). The Translocation Contractor will assess the following issues relevant to the location of Planting Areas:

- Existing threatened plants;
- Services;
- Services easements;
- Overhead powerlines;
- Access roads/tracks;
- Allotment boundaries;
- Access to water supply for the planting (if available);
- Flooding levels; and
- Existing vegetation.

The Translocation Contractor is required to set out the four Planting Areas without obstruction access to parts of the Offset Site and no planting is to be carried out within 10 m of the allotment boundary.

The dense *M. irbyana* thickets in the TEC have a closed forest structure like rainforest and therefore a rainforest planting model could be used. In rainforest revegetation, tree spacing is typically 1.8 m, so for 1 ha 3000 tubestock are required. To achieve the dense, monospecific stand of M. irbyana in the TEC, plant spacing will be 2m x 2m, or 2500 per ha.

A total of 5600 will be planted at the Recipient Site and 1000 kept in reserve for replacements or additional plantings if needed.

The total number of tubestock to be propagated is based on the following considerations:

- *Melaleuca irbyana* TEC is usually a dense, monospecific, closed canopy plant community.
- Plant spacing to be 2 m x 2 m or 2500 plants/ha.
- Relatively close planting will facilitate formation of a closed canopy (i.e crowns touching or closely packed) stand of *M. irbyana.*
- The plant spacing factors-in natural thinning and selective suppression of individuals by competition, water stress, culling of unsuitable genotypes etc to 4 m x 4 m or approximately 500 plants/ha, over 5 years.
- Based on observations of this species, time required for formation of a closed-canopy stand with an average height of 5-6 metres is estimated at a minimum of 10 years.

Plants will be introduced to the Planting Areas as follows:

- 5000 *Melaleuca irbyana* will be planted in Planting Area 1 (Figure 4) covering approximately 2 ha.

- The whole of Area 1 covers 2.8 ha and the remaining 0.8 ha will be used for access, 10 m fence buffer, habitat planting buffer and firebreak.
- 300 *Melaleuca irbyana* will be planted in Planting Areas 2-5 (Figure 4).
- Total tubestock required is 5000 + 600 = 5600 + 1000 in reserve for replanting = 6600.
- Approximately equal numbers of seedlings from swale or rise provenances will be randomly planted in each planting area.
- A section of each Planting Area will be reserved for a Reciprocal Planting Trial and marked with corner pegs.
- The Reciprocal Planting Trial in each Planting Area will include 50 plants, 25 from swale, 25 from rise. The other plants in each Planting Area will combine swale and rise plants in equal number and randomly selected.
- In each Planting Area, roughly equal numbers of seedlings from swale or rise provenances will be randomly planted.
- Monitoring of seedling performance in the Planting Area will be recorded only in the Reciprocal Planting Trial, which should be representative of the Planting Area in soil, vegetation and topography.
- Genetic diversity will be promoted by introducing seedlings propagated from all 20 trees in the Subject Sitein each Planting Area.

5.2.5 Fencing

Permanent, cattle-proof fencing with gates at appropriate points will be erected around the perimeter of the Offset Site. Cattle grazing will be removed from the Offset Site. Fire hazard resulting from long grass will be reduced by strategic burns and tractor slashing. Kangaroos are unlikely to graze *M. irbyana* seedlings and wallabies appear to be absent from the local area.

5.3 Planting of propagated individuals

The planting of all propagated plants will be carried out by a suitably qualified and experienced Revegetation Contractor or Bush Regenerator, supervised by the Translocation Contractor, as follows:

- Tubestock shall be set out in accordance with Section 5.2.4
- All plants shall be:
    - Watered 1 – 2 hours prior to planting;
    - Planted with 12-month slow-release fertiliser;
    - Watered, on the day of installation until soil is moist to 30 cm in depth.
    - Follow-up watering shall be applied to ensure the soil does not become excessively dry.
- All plants in the Reciprocal Planting Trial (50 in each Planting Area) shall be:
    - Identified and tagged with a unique identifier code;
    - Tubestock to be installed as per other plants (see above).

5.4 Mulching

Where mulch is deemed to be required by the Translocation Contractor, the mulch shall be weed free and installed as follows:

- Within three days of the completion of planting;
- Spread to 50 mm and is to be installed at the base of plants and mulch shall not be in contact with the plant stem.
- Only mulch free of weed seed will be used.

5.5 Installation of propagated plants reporting requirements

A post-installation report is to be prepared by the Translocation Contractor to be submitted to the Environmental Manager after completion of planting.

The report shall include, as a minimum, the following:

- Maintenance works undertaken to prepare the Recipient Sites;
- All weeds identified within the Planting Areas and method of treatment;
- Weed, pest and disease management measures undertaken within the Planting Areas;
- Description of propagation planting works undertaken;
- Issues encountered during propagation planting and actions required to remedy the issues;
- Watering application dates and volumes;
- Proposed adaptive management measures (if required); and
- Recommendations for further works required.

5.6 Completion of planting

The installation of propagated plants shall be deemed completed when the Planting Area has met the following completion criteria:

- The Planting Areas has been surveyed and boundary markers are visible.
- All weeds have been treated and are not inhibiting the growth rates of the plants;
- The required number of propagated plants have been planted in accordance with Section 5.2.4;
- The planted individuals:
  - Show no signs of nutrient deficiency;
  - Show no signs of water deficiency;
  - Show no signs of pests impacts;
  - Have been treated appropriately where there is a risk of disease;
  - Are established and well formed, showing evidence of growth typical of the species; and
  - Have a 50 mm mulch depth (as applicable).

Upon completion of the planting of all propagated individuals, the Planting Areas shall be inspected by the Environmental Manager and if deem compliant, a notification of the Commencement of the Establishment Period will be issued to the Translocation Contractor by the Environmental Manager.

6 Post-translocation actions – establishment period

6.1 General

The Establishment Period shall commence when the installation of propagated plants is deemed compliant, and a Certificate of Commencement of the Establishment Period has been issued by the Environmental Manager.

The Establishment Period shall be a minimum of 90 days. During the Establishment Period, the Translocation Contractor shall care for the salvaged and/or propagated plants to ensure their long-term viability and to meet the completion criteria detailed in Section 5.6.

The following sections detail the works required as part of the Establishment Period.

6.2 Establishment period schedule

The Translocation Contractor is to prepare a schedule for the duration of the Establishment Period addressing the requirements in the following sections, to be approved by the Environmental Manager.

6.3 Watering

The watering requirements are to be determined by the Translocation Contractor. However, the following is to be used as a guide for determining watering requirements:

- Watering is required to be undertaken every 2-3 days for the first two weeks;
- Watering is required once every 4-5 days for the following five weeks; and
- Watering once every 1-2 weeks until the completion of the Establishment Period.

During the Establishment Period, watering shall be conducted in a manner that does not cause waterlogging, run-off, erosion in the Planting Areas. Watering frequency will depend on the weather and tendency of the soil become waterlogged or boggy if overwatered. (Seedlings may be planted with water crystals to reduce foot traffic over the site's heavy clay soil during watering.)

6.4 Fertiliser

The fertilising requirements are to be determined by the Translocation Contractor. 12-month slow release for natives will be applied to promote plant health and achieve the Establishment Period completion criteria.

6.5 Weed, pest and disease control

All weeds within the Planting Area are to be treated to ensure weeds are not hindering the growth of the introduced plants.

Where pest and diseases are identified, all plant are to be treated appropriately to ensure the continued health and growth of the plants, while also considering potential side effects.

6.6 Replacement of failed plants

The Translocation Contractor is required to re-install failed or damaged plants to ensure a minimum of 80% of the initial number of plants are present at the completion of the Establishment Period.

The damaged or failed treatments are required to be re-installed as soon as is reasonably practical upon identification of the failed or damaged treatments.

Replacement plants will come from the back-up store of propagated plants.

Prior to re-installation, the Translocation Contractor shall investigate the failed plants to determine the cause of the poor performance, damage, or failure.

In the event that more plants are required, they will be propagated from remaining seed collected at the Subject Site, as previously described.

6.7 Topping up of mulch

Thirty days before the completion of the Establishment Period, where mulch has been applied to plants, the mulching treatment shall be inspected and topped up with mulch to achieve the originally specified depths (50 mm) if likely to be beneficial to plant growth.

6.8 Establishment period reporting requirements

A progress report is to be prepared by the Translocation Contractor at the half-way point (45 days) and a final report at the end of the Establishment Period.

The reports shall include, as a minimum, the following:

- Monthly program of maintenance works;
- Dates of maintenance visits and inspections;
- Maintenance works undertaken;
- Maintenance works in progress;
- Watering application dates and volumes;
- Weed, pest and disease management measures undertaken;
- Failed or failing plants and suspected cause of failure;
- Repair or re-installation of failed plants;
- All weeds identified within the Planting Area and method of treatment;
- Issues identified during inspections and actions required to remedy the issues;

- Damage to plants including damage caused by vandalism and/or theft;
- Proposed adaptive management measures (if required); and
- Recommendations for further works required.

6.9 Completion of the establishment period

The Establishment Period shall be completed when the Planting Area has met the following completion criteria:

The Planting Area is free from all weeds and weeds are not hindering the growth rates of the plants;

The installed plants:

- Show no signs of nutrient deficiency;
- Show no signs of water deficiency;
- Show no signs of pests impacts;
- Have been treated appropriately where impacted by pests and/or disease;
- Are established and well formed, showing evidence of growth typical of the species;
- Have a healthy root system that has penetrated into the ground so that the plant cannot be easily lifted out of the ground;
- Have a 50 mm mulch depth (as applicable); and
- The Planting Area has been established for a minimum 90-day duration.

Upon completion of the Establishment Period, the Planting Area shall be inspected by the Environmental Manager or their representative. Where the Planting Areas are deemed to be compliant, a Certificate of Completion of the Establishment Period shall be issued to the Translocation Contractor by the Environmental Manager.

7 Post-translocation actions

7.1 Maintenance

Following completion of the Establishment Period, maintenance will be carried out to ensure the plantings remain in healthy condition and actively growing.

On-going site maintenance will be required for a minimum of five years or until the plantings are well established and habitat is in good condition. Maintenance each year will involve weed control and fire break maintenance, and possibly other measures as described in the following sections.

7.1.1 Weed control

Weed control would be carried out to ensure the plantings are kept free of significant competition from introduced grasses and broad-leaved weeds (enough to retard growth). The herbicide Round-up Biactive (glyphosate 360 without surfactant) or similar would be used to minimise potential impacts on permanent and ephemeral aquatic habitat.

Weed control by herbicide spraying or brushcutting will be carried out 3 times each year for five years to ensure weeds and pasture grasses are suppressed and do not inhibit establishment of *M. irbyana* seedlings.

All weed control work would be carried out by experienced and suitably licensed bush regenerators and supervised by the Translocation Contractor.

7.1.2 Fire break maintenance

A perimeter fire break of tractor tilled soil would be maintained around each Planting Area during the dry season when grass fires may occur. Even though *M. irbyana* appears to have a relatively high degree of fire resilience even when small (see Section 4.2), it is advisable to avoid fire setting back growth or even killing seedlings during the first few years of growth.

7.1.3 Watering during drought

Following completion of the Establishment Period, watering would be carried out during any prolonged dry spell in the first two years after planting, if deemed necessary after examining the soil and assessing soil moisture availability. Care would be taken not to over-water and produce boggy soil conditions.

7.1.4 Pest and disease control

The plantings will be monitored for Insect pests and diseases. In the event of serious insect pest or disease damage to the plantings, which is considered unlikely, possible control measure (i.e. spraying using pyrethrum) will be considered and may be implemented.

7.1.5 Checking and repair of fences

The fences will check for damage and kept in good repair.

7.2 Habitat restoration

Habitat restoration works will be carried out as part of general management of the Offset Site and is mostly separate to this Translocation Plan. However, as part of this plan, tubestock planting of local tree and understory species propagated from locally collected seed would be carried out in a 20 m wide buffer surrounding each Planting Area, to promote restoration of good quality habitat to the Recipient Site.

7.3 Monitoring program

7.3.1 Objective

The objective of monitoring is to record the results of translocation, including information that can be used to evaluate its success and identify causes of survival or mortality. Monitoring of the translocations will be conducted after introduction to the Recipient Site for a minimum of 5 years. An additional objective from the reciprocal planting trial will be to determine how sensitive *M. irbyana* performance is to local genetic provenance.

7.3.2 Monitoring schedule

Following completion of the Establishment Period (90 days or 3 months), monitoring of the four Planting Areas, including the Reciprocal Planting Trial within each Planting Area will be carried out quarterly for the remaining 9 months of the year (12 month period); 6 monthly in Year 2 (the second 12 month period) and once a year for 3 years, a minimum total monitoring period of 5 years.

If any significant benefit is likely by continuing the monitoring for longer (e.g. slower than expected growth of trees, likely change in survival rates, significant data from the experiment), monitoring would be continued as advised by the Translocation Contractor.

7.7.3 Planting Area – monitoring data

Excluding the Reciprocal Planting Trial, the following data will be recorded in each Planting Area at each monitoring event:

- A count of the number of dead plants
- A count of the number of plants in poor condition (e.g. yellow or discoloured foliage, defoliated)
- A count of the number of plants in good or satisfactory condition
- Average plant height as determined by measuring the heights of a random sample of 20 plants (Planting Area 1) or 15 plants (Planting Areas 2-4)
- Any evidence of insect grazing.
- Any evidence of mammal grazing.
- Any evidence of disease.
- Evidence of flowering and seed production (possible after 4-5 years)
- General plant condition – is growth adequate?
- Abundance of exotic species – commonest six species and cover-abundance.
- Are exotic species being adequately controlled?
- General habitat condition.

7.7.4 Reciprocal Planting Trial – method and monitoring data

As described in Section 3.8, he Reciprocal Planting Trial will compare performance of swale and rise provenances on four different soils – i.e. the four Planting Areas – as follows:

- The trial plots (4) will be 20 m x 20 m with clearly marked corners and intermediate stakes.
- Each trial will contain 50 seedlings, 25 seedlings from swale, 25 from rise.

- The swale and rise seedlings will be tagged with a unique id code prior to planting indicating whether swale of rise provenance and a unique number (1-200).
- Id codes will be written on tag with a paint marker pen.
- The tagged seedlings will be planted in random arrangement – suggest mixing 50 tagged plants up in a tray before planting and then picking out at random.
- A plastic nursery pot tag with the plant id code will be inserted in the soil at base of each plant in case the tags are lost.
- A map will be prepared showing the location of each tagged individual from gps coordinates.

Monitoring will follow the same schedule as the rest of the Planting Area. At each monitoring event the following data will be recorded for each tagged individual:

- Unique Id number – e.g. Planting Area 1: S-4, R–33 etc.
- Plant height
- Plant condition – dead, poor, good
- Leaf condition
- Grazing
- Disease
- New shoot growth present/absent
- Other morphological attributes to be determined after observing seedling growth.

7.7.5 Reference Sites

One 10 m x 10 m vegetation monitoring plot will be established in the three Reference Areas examined during preparation of this Plan:

- Mill St, Rosewood
- Warrill Park Lawn Cemetery
- Purga Nature Reserve

The corners of each plot will be marked with stakes and GPS coordinates of the plot centre recorded. The following monitoring data will be recorded in each plot:

- Species composition and abundance
- Height and condition of all *Melaleuca irbyana* individuals, which will be tagged with a unique identifier code for subsequent monitoring.

- Evidence of dieback and disease.
- Evidence of new growth – i.e. new shoots.
- Evidence of flower and seed production
- General habitat condition.

7.7.6 Translocation monitoring report

An annual translocation monitoring report would be prepared at the end of each 12-month monitoring period, which will include the Reciprocal Planting Trial and Reference Sites.

The report would include the following information: -

- Background and description of the translocation project.
- A description of translocation methods.
- A description of monitoring methods.
- An analysis of monitoring data on a species by species basis;
- An assessment of causes of plant mortality.
- An assessment of the success or failure of the translocation
- An evaluation of the methods and cost-effectiveness of the translocation project.
- Work plan over the next twelve months including maintenance, replacements if required and management of the translocation site.

8 Performance criteria

The primary aim of the Translocation Plan is to establish a new area of Swamp Tea-tree TEC to compensate for loss of population and habitat on the development footprint and that the planting will be healthy, free of disease and pests, growing well and likely to become self-sustaining beyond the post-translocation maintenance and monitoring period. Towards this end goal the outcomes of implementation of the Translocation Plan for *Melaleuca irbyana* will be assessed against the Performance Criteria in Table 3. The Performance Criteria will be assessed in each annual monitoring report. (Note – additional criteria pertain to the Establishment Period as described in Sections 6.8 and 6.9).

Table 3: Performance criteria for assessing success of implementing the *M. irbyana* Translocation Plan, to be evaluated in each Annual Monitoring Report.

No.	Performance criteria	2022	2023	2024	2025	2026
1	Propagation and introduction of *M. irbyana*	Assessment scoring: 3 fully implemented/ achieved;2 partly implemented/partly achieved; 1 failed				

No.	Performance criteria	2022	2023	2024	2025	2026
1.1	Seed collected across the development footprint in separate swale and ridge provenances, as described in Sect. 3.5					
1.2	Approximately 6600 tubestock comprising 50% swale and 50% ridge plants were propagated.					
1.3	Seedlings were in good condition, 12 months old, well hardened-off and free of disease when planted.					
1.4	5600 seedling Tubestock were introduced in four Planting Areas and 1000 kept in nursery as replenishment stock for any plant mortalities as described in Sect. 5.2.2					
1.5	Approximately 80% of tubestock were introduced to Planting Area 1 (structured Vertisol next to Rosewood – Laidley Rd)					
1.6	Reciprocal Planting Trials (both provenances in one site) established in each Planting Area, as described in Sect.5.7.4.					
2	Maintenance					
2.1	Cattle proof fencing will be erected around the whole Offset Site (with four Planting Areas)					
2.2	Watering carried out as described in Sect. 6.3					
2.3	Certificates of Commencement of Establishment Period (90 days) and Completion of Established Period were issued.					
2.4	On-going maintenance carried out during each year for a total of five years as described in Sect. 7.1					
2.5	Weed control in the four Planting Areas carried out three times per year for 5 years.					
2.6	Habitat restoration planting carried out in a 20 m buffer zone around each Planting Area					
3	Monitoring					
3.1	Monitoring of four Planting Areas and four Reciprocal Planting Trials carried out 4 times a year in Year-1, twice in Year-2 and once a year in Years 3-5.					

No.	Performance criteria	2022	2023	2024	2025	2026
4	Reporting					
4.1	Establishment period reporting completed as described in Sect. 6.8					
4.2	Annual Monitoring Report completed as described in Sect. 5.7.6					
5	M. irbyana survival rates					
5.1	>80% at end of Establishment Period					
5.2	>70% at end of Year 1					
5.3	>60% at the end of Year 2					
5.4	>60% at end of Year 3					
5.5	>50% at end of Year 4					
5.6	>50% at end of Year 5					
6	M. irbyana Forest					
6.1	A dense thicket of M. irbyana equivalent to the TEC formed in Planting Area 1 after 5 years					

9 References

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Plate 2 (above): Subject Site, flat swale area with large *M. irbyana* tree growing with *Lophostemon suaveolens* and *Eucalyptus tereticornis.* The spreading growth form indicates the area was largely cleared when the tree regrew, probably after clearing. It is surrounded by sapling regrowth.

Plate 3 (left). Subject Site, coppiced (multi-stem) *M. irbyana* tree growing in flat swale area. This tree was 8-9 metres high.

Plate 4 (left). Subject Site, large, coppiced *M. irbyana* tree growing on a gentle hillslope between swales. The soil profile here had a silty sand topsoil and clay subsoil.

Plate 5: Recipient Site. The southwest corner of the site has an existing population of *M. irbyana* population. See large *M. irbyana* trees on the left hand side and Lantana in foreground.

Plate 6: Recipient Site. Woodland at southwest end of site with *Angophora leiocarpa, E. tereticornis, E. melanophloia, Corymbia tesselaris*. *M. irbyana* in background on left.

Plate 7: Recipient Site. Base of slope southwest end of site with remnant woodland, similar to rise section of the Subject Site.

Plate 8: Recipient Site. Base of slope southwest end of site with remnant woodland, similar to rise section of the Subject Site. *M. irbyana* and *Angophora leiocarpa*.

Plate 9: Recipient Site. Flat habitat with poorly drained soil that extends from the southwest end over 90% of the site. Grasses, sedges, sapling regrowth and one *M. irbyana* on right hand side.

Plate 10: Recipient Site. Flat habitat with poorly drained soil and remnant stand of dense *M. irbyana* forest. *Corymbia tesselaris* saplings on left hand side.

Plate 11: Reference Site -Warrill Park Lawn Cemetery. Closed forest of *M. irbyana* next to cemetery.

Plate 12: Reference Site – Purga Nature Reserve. This reserve 9 km south of Yamanto and 15 km south of Ipswich protects one of the largest remaining stands of *M. irbyana* forest.

APPENDIX 1: *Melaleuca irbyana* individuals recorded within the Subject Site at North Maclean in November 2022. **Individuals occurring in groups are indicated by yellow highlight, single isolated/separated trees by blank.**

Id No.	Lat (WGS 84)	Long (WGS 84)	DBH	Ht	Coppice Stems	Grouping (yellow)	Comment
MI-1	-27.767894	153.016433	30	9.5			highway edge
MI-2	-27.769687	153.01571	35	12.5			2 trunks
MI-3	-27.769618	153.015512	28	9.5			
MI-4	-27.768056	153.015454	14	10.2	4		
MI-5	-27.768098	153.015465	22	10.5			
MI-6	-27.76809	153.015464	14	8.4			
MI-7	-27.769166	153.014646	30	10.2		group	7&8 50 cm apart
MI-8	-27.769165	153.014659	23	9.2			
MI-9	-27.769172	153.014563	9	8.3			
MI-10	-27.769148	153.014572	10	6.5			dieback
MI-11	-27.768066	153.01474	26	8.3			
MI-12	-27.768152	153.014567	18	4.8		group	spreading, 2 trunks
MI-13	-27.768134	153.01454	28	6.5			
MI-14	-27.768113	153.014478	25	7.1	4		
MI-15	-27.768094	153.014498	27	10.5			2 stems dead, 6 cm dbh
MI-16	-27.768081	153.014494	12	6.6			
MI-17	-27.768084	153.014494	16	6.2			4 stems dead up to 10 cm dbh
MI-18	-27.768055	153.014528	12	7			
MI-19	-27.768045	153.014528	26	7.1	2		
MI-20	-27.768037	153.014551	28	8.5			forks above ground
MI-21	-27.768053	153.014448	10	5.7	2		
MI-22	-27.767962	153.014429	9	6.8	2		
MI-23	-27.767996	153.014406	28	9.4	4		

MI-24	-27.768083	153.014437	10	4.8	3		
MI-25	-27.768087	153.014454	9	6			2 stems dead
MI-26	-27.768103	153.014469	17	7.4			
MI-27	-27.768133	153.014445	7	3.8			
MI-28	-27.768105	153.0144	28	7.5			
MI-29	-27.768132	153.014465	16	7.5	2		
MI-30	-27.768224	153.014502	5	3.8			little one by itself but in group
MI-31	-27.768329	153.014719	0	6.5	3	group	
MI-32	-27.768338	153.014688	16	7.5			
MI-33	-27.768428	153.014702	12	9	2		
MI-34	-27.768385	153.014847	10	7			single by itself
MI-35	-27.76851	153.014717	9	6.4			
MI-36	-27.768909	153.014456	25	9.3			
MI-37	-27.769392	153.013115	25	10.5			
MI-38	-27.769378	153.013081	8	5.8		group	
MI-39	-27.769382	153.013095	30	10.5			
MI-40	-27.769387	153.013069	9	6			
MI-41	-27.769383	153.013065	12	9			
MI-42	-27.769389	153.013062	2.5	4			
MI-43	-27.76942	153.012995	14	8.2		group	
MI-44	-27.769432	153.012965	?	1.8			cut reshot
MI-45	-27.769443	153.012958	?	0.5			cut reshot
MI-46	-27.769434	153.012964	10	8.2			
MI-47	-27.769444	153.012958	10	7.8	2		
MI-48	-27.769454	153.012952	11	7.8			
MI-49	-27.769445	153.012931	15	8.4	6		
MI-50	-27.769458	153.012945	9.2	11	2		
MI-51	-27.769441	153.012936	?	0.6			cut reshot

MI-52	-27.769456	153.01297	14	7.1	4		
MI-53	-27.769449	153.012994	11	9.1			
MI-54	-27.769467	153.012975	6	6.5			
MI-55	-27.76945	153.012998	12	8.8	5		
MI-56	-27.769448	153.013003	10	10.5			
MI-57	-27.767903	153.013331	10	6.2			dry on a hill
MI-58	-27.767869	153.012914	35	11		group	on hill
MI-59	-27.767855	153.012957	35	11			
MI-60	-27.767861	153.01297	12	10.5	2		
MI-61	-27.767881	153.012973	14	8.4	2		
MI-62	-27.767872	153.01298	5	4.7			
MI-63	-27.767854	153.012981	40	10	5		
MI-64	-27.76786	153.013011	14	10.5	2		
MI-65	-27.767832	153.013001	8	4			dieback
MI-66	-27.767826	153.012994	8	5			dieback
MI-67	-27.767838	153.012957	14	11			
MI-68	-27.76783	153.012942	17	11			
MI-69	-27.767806	153.012953	15	10.2			
MI-70	-27.767806	153.012989	14	9.5	3		
MI-71	-27.767805	153.012987	10	9.5			
MI-72	-27.767804	153.012981	16	10	2		
MI-73	-27.767811	153.013008	14	9.8	2		
MI-74	-27.769041	153.011046	21	8.4	6	group	
MI-75	-27.769128	153.011004	16	7.2	2		
MI-76	-27.769152	153.010979	15	9.5	2		on hill top
MI-77	-27.769123	153.010869	30	11	3		12 m wide
MI-78	-27.767072	153.011451	30	10.1			forking trunk on hilltop
MI-79	-27.767131	153.010937	20	9	2		
MI-80	-27.767294	153.010889	30	12	9	group	big plant

MI-81	-27.767291	153.010865	3	3			
MI-82	-27.767309	153.010875	9	6.7			
MI-83	-27.767316	153.010841	11	10.5			
MI-84	-27.767264	153.010757	13	8.4			
MI-85	-27.767601	153.010869	27	11.1	2		big coppice stems
MI-86	-27.767834	153.010059	30	9			
MI-87	-27.767759	153.010088	30	9.2			
MI-88	-27.767708	153.009971	23	9			
MI-89	-27.767505	153.010059	22	11	7		
MI-90	-27.768522	153.010248	7	6	2		
MI-91	-27.768629	153.010337	25	10.2			
MI-92	-27.768635	153.010395	9	8.6	3		
MI-93	-27.768556	153.010415	6	7.1	3		
MI-94	-27.768784	153.010607	25	10.1			
MI-95	-27.768679	153.009704	<	0.5	6		one by itself, only small one on whole site

APPENDIX 2: *Melaleuca irbyana* - Soil Profile Description and Chemical Analysis

Soil properties can be critical to the outcome of threatened plant species translocation. To examine the soil type associated with *M. irbyana* and the suitability of potential recipient sites, soil profiles were recorded at the donor and recipient sites (Figure 1) and soil samples collected for nutrient analysis. A soil auger was used to examine the soil profile to a depth of 50 cm, noting soil horizons, colour and field texture, and 1 kg soil samples collected from the topsoil (0-8 cm) and subsoil (40-50 cm) for chemical analysis. Three additional sites southeast of Rosewood supporting existing stands of *M. irbyana* were recorded as reference areas and soil samples collected to compare with the donor and recipient sits (Figure 1). Soil analysis was carried out by the Environmental Analysis Laboratory (EAL) at Southern Cross University (Lismore).

Results are present below for each soil profile including a diagram of soil horizons and photo of the soil core, results of soil chemical analysis by EAL, and a summary of soil chemical properties for soil profiles from the donor, recipient and reference sites.

Soil types were interpreted using the Ipswich City Council Soil Management Guidelines (https://www.ipswich.qld.gov.au/ data/ assets/pdf_file/0005/42557/soil-management-guidelines.pdf), Qld Globe (https://qldglobe.information.qld.gov.au/) and McKenzie *et al.* (2004).

At the Subject Site on the Mt Lindsay Highway in Logan City Council, there were differences in soil profile on flats and rises where *M. irbyana* grows (see soil profile diagrams below). The soil profile on rises had a pale brown, silty sand textured A1 horizon (topsoil), slightly paler A2 horizon and clay textured B horizon (subsoil). On the flat, the soil had a pale, clay textured A horizon above a heavier, clay textured B horizon.

In terms of the classification of soil orders (McKenzie *et al.* 2004), soils in the area of the donor and recipient sites consist mainly of Kandosols (deeply weather clays, no strong texture contrast) and Vertosols (cracking clays). Sodosols (ph> 5.5 and sharp texture contrast) also appear to be present on rises at the Subject Site and footslopes at the recipient site.

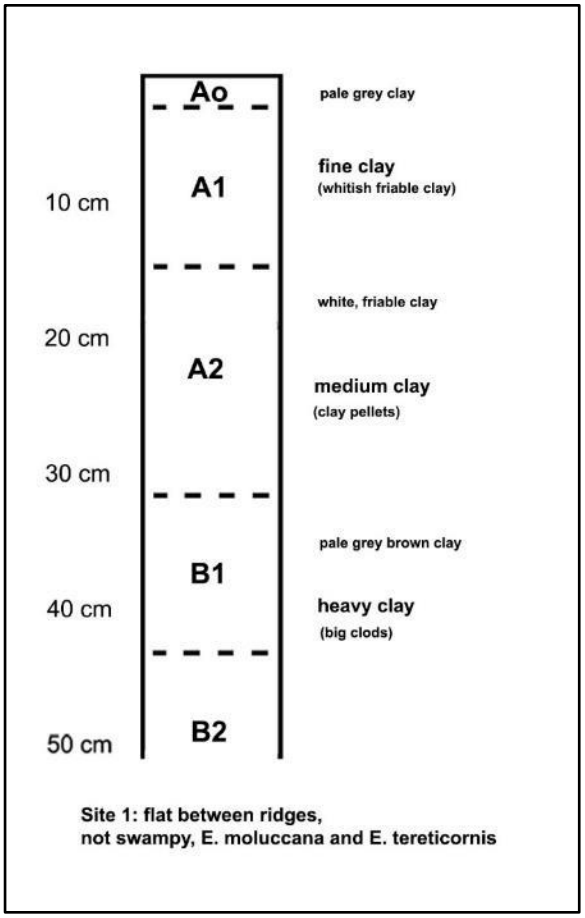
The three reference sites with stands of *M. irbyana* were on Vertosols (see McKenzie et al. 2004, p. 366), whereas the rises and lower slope at the donor and recipient sites were on Kandosols or Sodosols. The flat at the recipient site appeared to be Sodosol grading into Vertosol at the southern end of the site and Vertosol to the north, covering most of the site. Soil profile Site 13 (R-L SS5) at the recipient site was similar to the reference sites (Site 5(7), Site 6(8) and Site 7(9).

Figure 1: Soil sample locations at the proposed Development Site (4 samples), Reference Sites (3 samples) and Translocation Recipient Site (6 samples)

Description of Soil Profiles at Donor, Reference and Recipient Sites

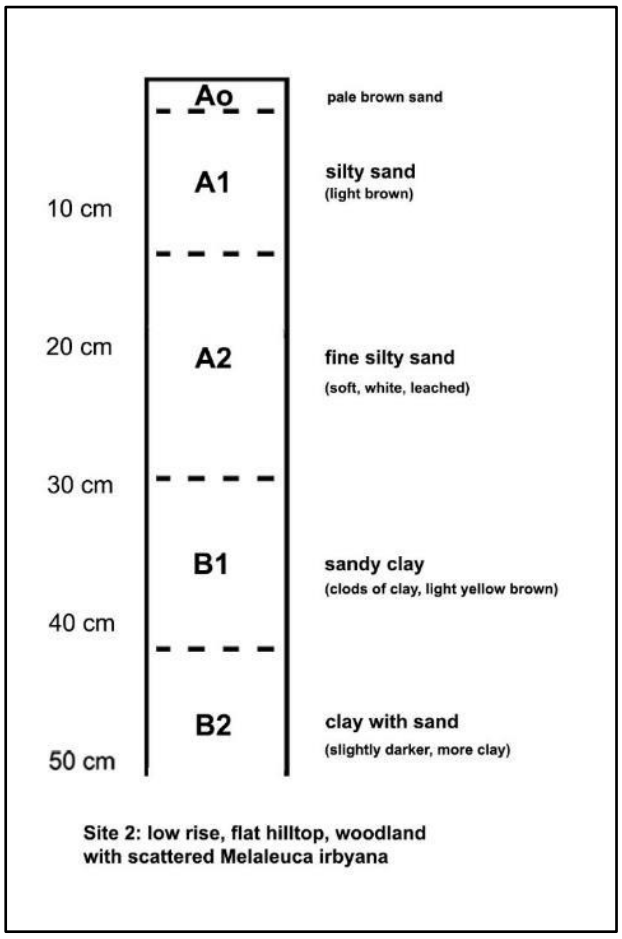
Site 1: Subject Site. Swale between slight rises, E. moluccana, E. tereticornis and Lophostemon suaveolens.

Soil Descripition: Kandosol. Shallow A1 (organic enriched) horizon, pale grey, slightly paler A2 horizon, and slightly browner at top of B horizon. Clay friable in A horizon, becoming heavy in the B horizon. Poorly drained.



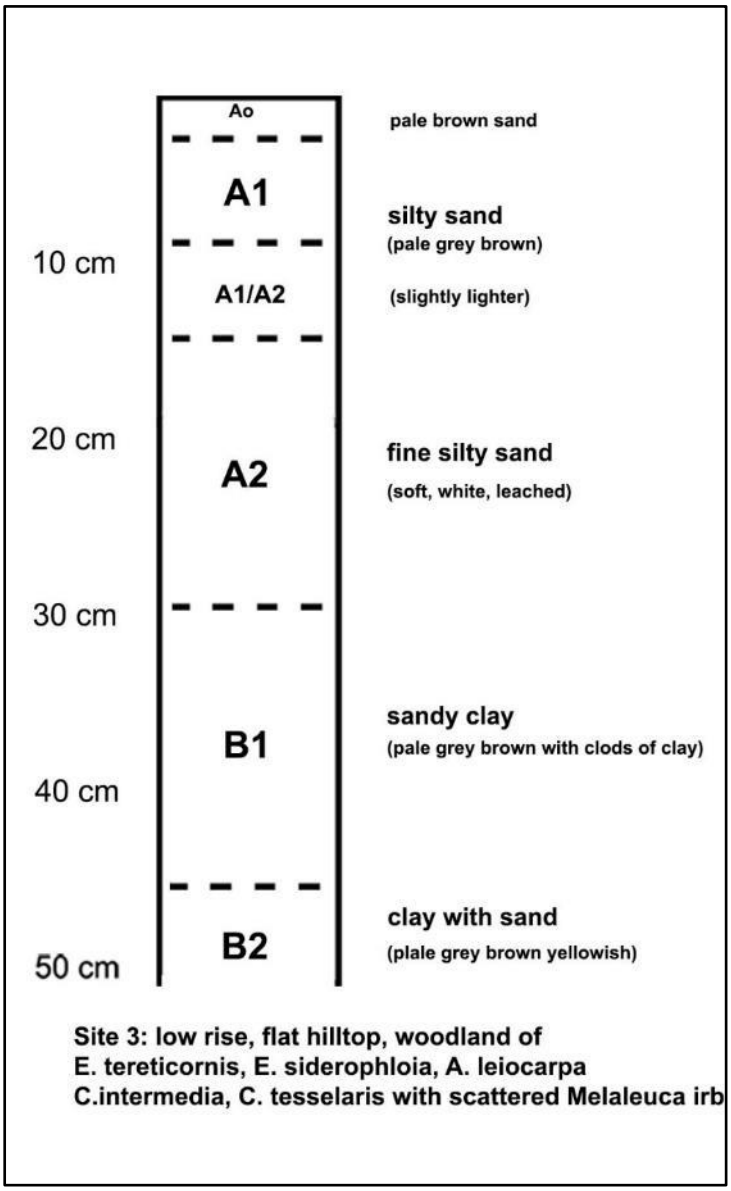
Site 2: Subject Site. Low flat topped rise with E. tereticornis, E. siderophloia, Corymbia tesselaris and Lophostemon suaveolens.

Soil Descripition: Sodosol. Pale grey A1 horizon of silty sand, off-white A2 horizon of fine silty sand, grading into clay textured B horizon. Well drained.



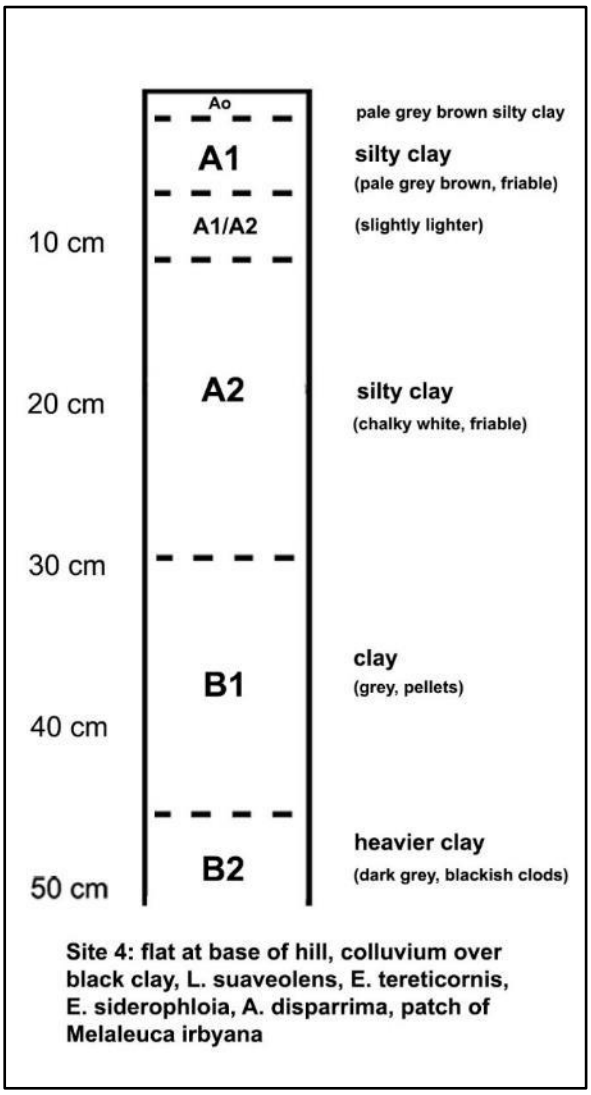
Site 3: Subject Site. Low flat topped rise with E. tereticornis, E. siderophloia, Angophora leiocarpa, Corymbia tesselaris and Lophostemon suaveolens.

Soil Descripition: Sodosol. Pale grey A1 horizon of silty sand, off-white A2



Site 4: Subject Site. Low lying flat between slight rises, E. tereticorns and Lophostemon suaveolens.

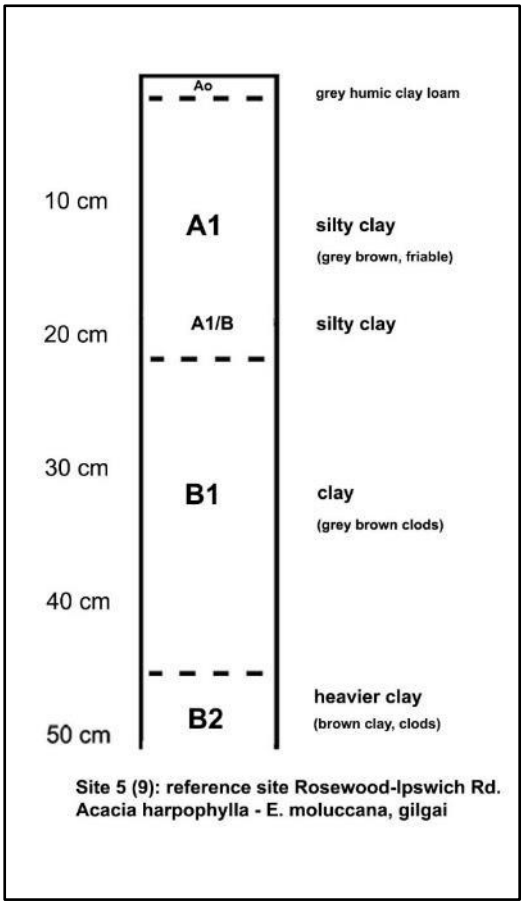
Soil Descripition: Kandosol (or Sodosol colluvium overlying Vertosol). Shallow silty clay A1 horizon, pale grey, slightly paler A2 horizon, and black-brown, clay B horizon. Hillslope colluvium overlying blackish heavy clay at edge of floodplain.



Site 4: flat at base of hill, colluvium over black clay, L. suaveolens, E. tereticornis, E. siderophloia, A. disparrima, patch of Melaleuca irbyana

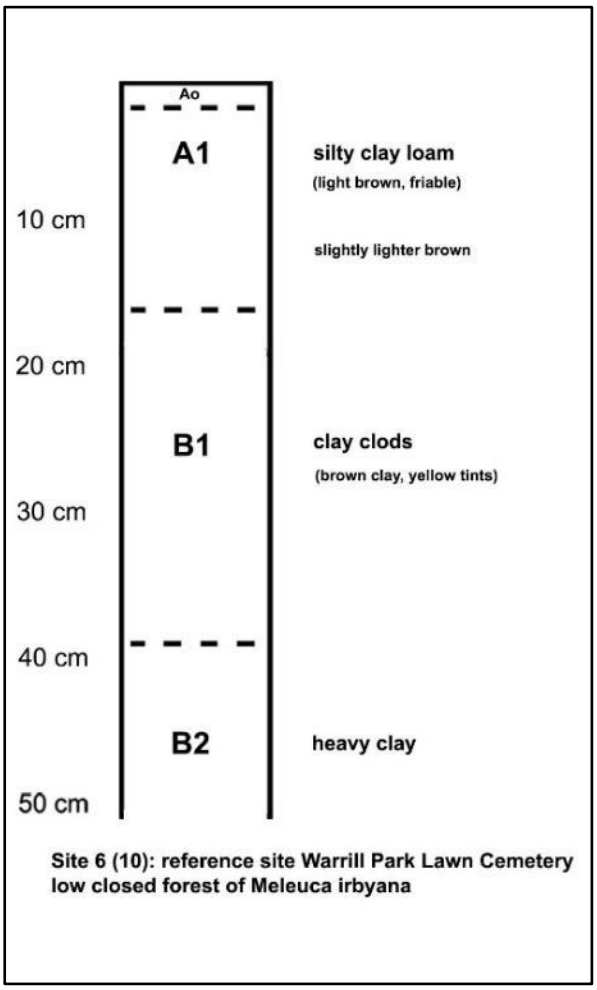
Site 9: Reference Site Mill St, Rosewoood; flat to very gently undulating, cleared with patches of remnant vegetation. Grey Box (*Eucalyptus moluccana*) and Brigalow (*Acacia harpophylla*), understory of *Melaleuca irbyana.*

Soil Descripition: Vertosol. Dark brown clay with little change in texture and colour. Poorly drained.



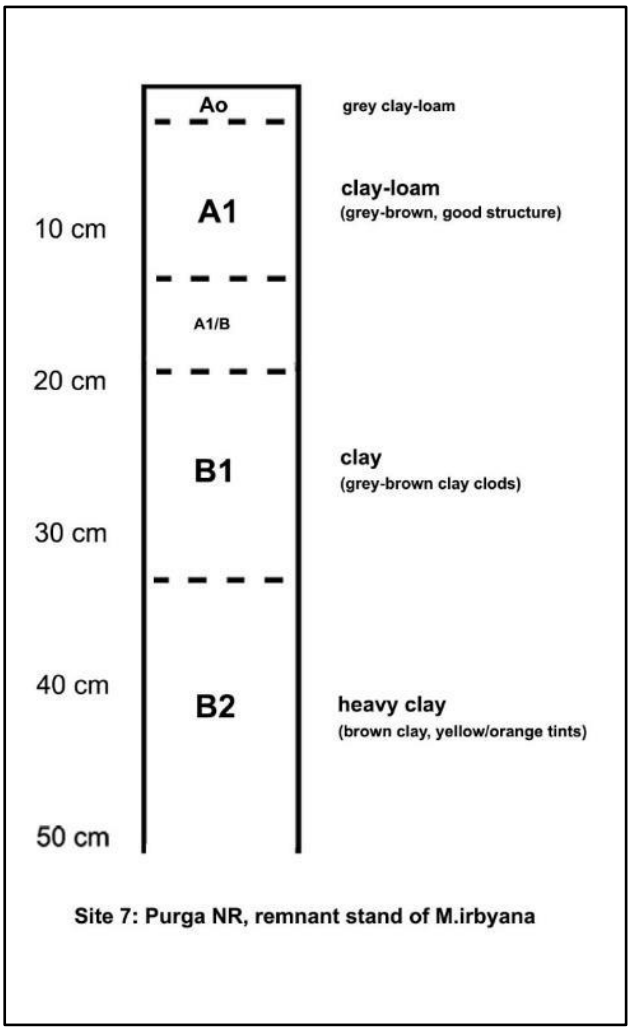
Site 10: Reference Site, Warrill Park Lawn Cemetery, Cunningham Highway; flat to very gently undulating, cleared, remnant closed forest of *Melaleuca irbyana*.

Soil Descripition: Vertosol. Dark brown clay with minor change in texture and colour. Poorly drained.



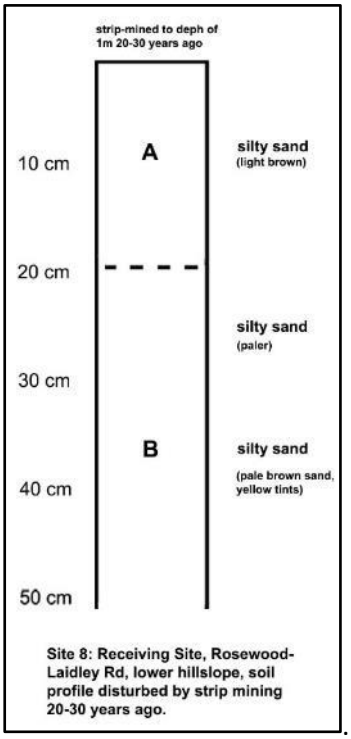
Site 11: Reference Site, Purga Nature Reserve, Cunningham Highway; flat to gently undulating, cleared, remnant closed forest of *Melaleuca irbyana*.

Soil Descripition: Vertosol. Deep, grey-brown clay with minor changes in texture and colour. Poorly drained.

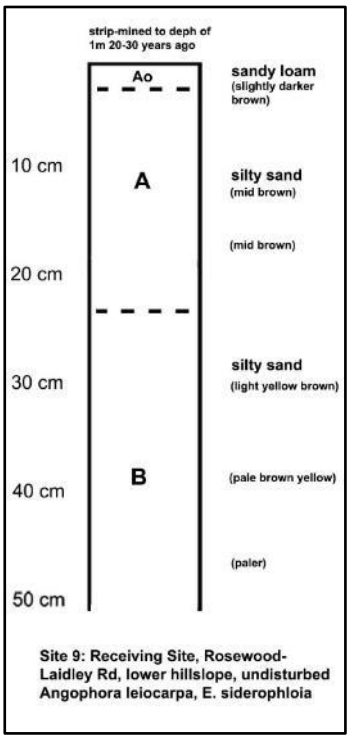


Site R-L SS1 &2: Recipient site, Rosewood-Laidley Rd, lower hillslope. Site 8 strip-mined to depth of 1 m about 30 years ago. Site 2 on far side of site, undisturbed. Photo Site 2.

Soil Descripition: Kandosol; deep, pale brown silty sand



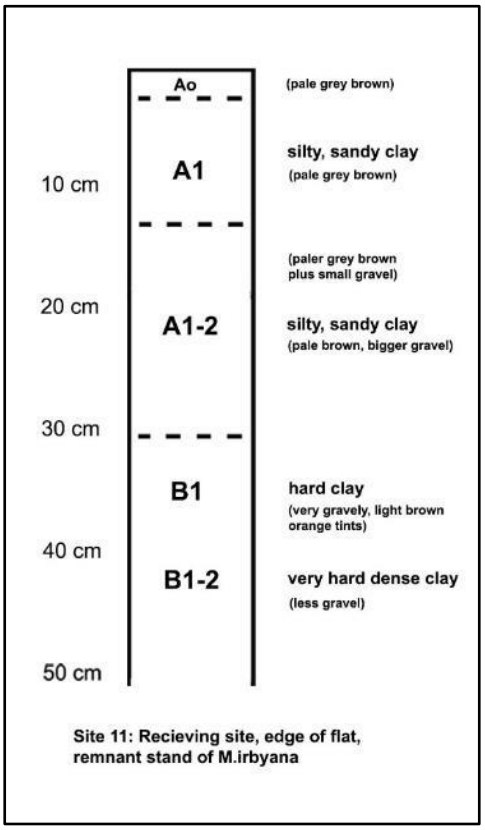
Site 8: Receiving Site, Rosewood-Laidley Rd, lower hillslope, soil profile disturbed by strip mining 20-30 years ago.



Site 9: Receiving Site, Rosewood-Laidley Rd, lower hillslope, undisturbed Angophora leiocarpa, E. siderophloia

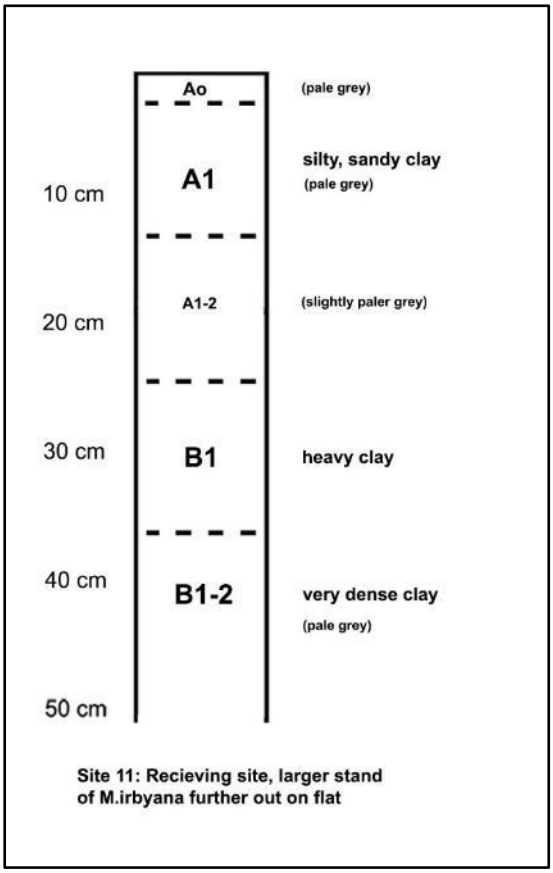
Site R-L SS3: Recipient site, Rosewood-Laidley Rd, edge of flat just out from base of slope, remnant stand of M. irbyana.

Soil Descripition: Sodosol. Light brown with silty, sandy, clay and gravel A horizon and dense clay hardpan B horizon starting at about 30 cm



Site R-L SS4: Recipient site, Rosewood-Laidley Rd, larger remnant stand of M. irbyana further out on flat.

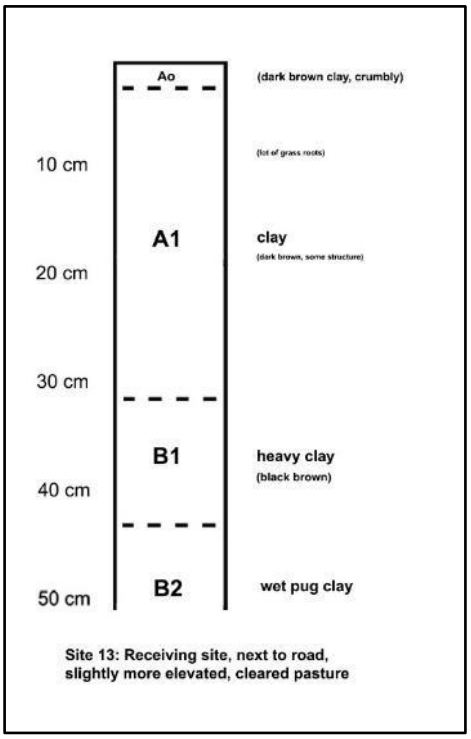
Soil Descripition: Sodosol. Pale grey with silty, sandy, clay and gravel A horizon and a dense clay hardpan B horizon starting at about 25 cm



Site 11: Recieving site, larger stand of M.irbyana further out on flat

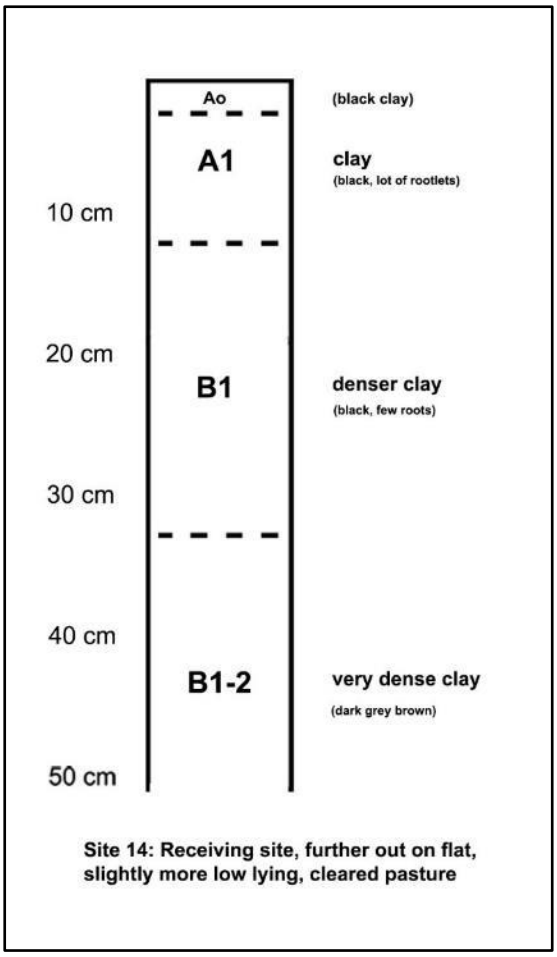
Site R-L SS5: Recipient site, Rosewood-Laidley Rd, flat alongside road, slightly more elevated, cleared pasture.

Soil Descripition: Vertosol. Dark grey clay with some surface structure, little change in texture and colour.



Site 14 (R-L SS6): Recipient site, Rosewood-Laidley Rd, further out toward centre of wide, largely cleard area. Slightly more low lying, wet site indicators.

Soil Descripition: Vertosol. Dark grey clay with poor structure, little change in texture and colour.



Site 14: Receiving site, further out on flat, slightly more low lying, cleared pasture

Soil Chemical Analysis Results

Table 1: Subject Site. Four soil profiles were sampled in groups of *Melaleuca irbyana* trees, which are scattered through the site. Two profiles were from patches of trees on flats or swales, and two from trees on low, gently sloping rises. Soil colour and texture were recorded to a depth of 50 cm. Soil samples were collected for chemical analysis at 0-8 cm and 30-40cm. A description of the soil profiles can be found in Figs x to x.

	Donor	Donor	Donor	Donor	Donor	Donor	Donor	Donor
	Swale		*Hill*		*Hill*		*Swale*	
Parameter	Sample 1 Site 1 # 1 0-8cm N4723/1	Sample 2 Site 1 # 2 30-40cm N4723/2	Sample 3 Site 2 # 3 0-8cm N4723/3	Sample 4 Site 2 # 4 30-40cm N4723/4	Sample 5 Site 3 # 5 0-8cm N4723/5	Sample 6 Site 3 # 6 30-40cm N4723/6	Sample 7 Site 4 # 7 0-8cm N4723/7	Sample 8 Site 4 # 8 30-40cm N4723/8
Phosphorus (mg/kg P)	5.8	3.8	2.1	3.3	2.3	2.7	4.8	1.5
pH	5.98	4.50	5.62	6.36	5.20	5.75	5.80	4.73
Electrical Conductivity (dS/m)	0.063	0.535	0.018	0.057	0.017	0.180	0.039	0.404
Estimated Organic Matter (% OM)	4.7	0.67	1.5	0.52	1.8	0.48	2.3	0.54
Exchangeable Calcium (mg/kg)	1,135	162	229	53	115	16	471	186
Exchangeable Magnesium (mg/kg)	382	812	72	765	67	934	173	978
Exchangeable Potassium (mg/kg)	143	<50	<50	<50	<50	<50	57	<50
Exchangeable Sodium (mg/kg)	41	864	24	295	<15	534	39	988
Exchangeable Aluminium (mg/kg)	2.2	629	22	32	33	61	8.8	297

Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)	9.4	18	2.2	8.7	2.0	12	4.3	19
Calcium (%)	60	4.4	52	3.0	28	0.69	55	4.8
Magnesium (%)	33	36	27	73	27	67	33	42
Potassium (%)	3.9	0.51	2.9	1.2	3.2	0.89	3.4	0.43
Sodium - ESP (%)	1.9	20	4.8	15	3.2	20	3.9	22
Aluminium (%)	0.25	38	11	4.1	18	5.9	2.3	17
Calcium/Magnesium Ratio	1.8	0.12	1.9	0.04	1.0	0.01	1.7	0.12
Total Carbon (%)	2.7	0.38	0.89	0.30	1.0	0.27	1.3	0.31
Total Nitrogen (%)	0.15	0.03	0.05	<0.02	0.04	<0.02	0.08	0.02
Carbon/Nitrogen Ratio	17	14	18	17	23	30	16	15
Basic Texture	Loam	Clay	Loam	Loam	Loam	Clay Loam	Loam	Clay
Basic Colour	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Grey	Brownish
Chloride Estimate (equiv. mg/kg)	40	342	11	36	11	115	25	258

Table 3: Reference Sites. Soil profiles were sampled at three reference sites containing *Melaleuca irbyana* populations – Rosedale, Cemetery and Purga Nature Reserve. Soil profiles were recorded and soil samples collected as described for the Subject Site in Table 1. A description of the soil profiles can be found in Figs x to x.

		Reference	Reference	Reference	Reference	Reference	Reference
		Rosedale		*Cemetery*		*Purga*	
		Sample 17 **Site 9 # 17 0-8cm**	**Sample 18** **Site 9 # 18 30-40cm**	**Sample 19** **Site 10 # 19 0-8cm**	**Sample 20** **Site 10 # 20 30-40cm**	**Sample 21** **Site 11 # 21 0-8cm**	**Sample 22** **Site 11 # 22 30-40cm**
Parameter		**N4723/17**	**N4723/18**	**N4723/19**	**N4723/20**	**N4723/21**	**N4723/22**
Phosphorus (mg/kg P)		2.4	1.0	2.4	<1	7.2	1.3
pH		6.25	6.49	6.39	4.95	6.67	4.88
Electrical Conductivity (dS/m)		0.063	0.760	0.044	0.569	0.068	0.688
Estimated Organic Matter (% OM)		6.9	0.75	4.3	0.82	6.7	1.3
Exchangeable Calcium	**(mg/kg)**	2,313	1,180	1,561	1,005	1,474	297
Exchangeable Magnesium	**(mg/kg)**	946	1,528	870	1,284	1,034	1,189
Exchangeable Potassium	**(mg/kg)**	162	50	133	<50	86	<50
Exchangeable Sodium	**(mg/kg)**	208	1,345	130	995	164	997
Exchangeable Aluminium	**(mg/kg)**	3.9	1.5	1.4	88	3.3	126
Effective Cation Exchange Capacity (ECEC) (cmol$_+$/k		21	24	16	21	17	18

Calcium (%)	56	24	49	23	44	8.5
Magnesium (%)	37	51	45	49	51	56
Potassium (%)	2.0	0.53	2.1	0.20	1.3	0.21
Sodium - ESP (%)	4.3	24	3.6	20	4.2	25
Aluminium (%)	0.21	0.07	0.10	4.6	0.22	8.0
Calcium/Magnesium Ratio	1.5	0.47	1.1	0.47	0.86	0.15
Total Carbon (%)	4.0	0.43	2.5	0.47	3.8	0.74
Total Nitrogen (%)	0.26	0.03	0.15	<0.02	0.24	0.04
Carbon/Nitrogen Ratio	16	16	16	38	16	18
Basic Texture	Loam	Clay	Loam	Clay	Loam	Clay
Basic Colour	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish
Chloride Estimate (equiv. mg/kg)	40	486	28	364	44	441

Table 3: Recipient Site. Soil profiles were sampled at three reference sites containing *Melaleuca irbyana* populations – Rosedale, Cemetery and Purga Nature Reserve. Soil profiles were recorded and soil samples collected as described for the Subject Site in Table 1. A description of the soil profiles can be found in Figs x to x.

	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient	Recipient
					M.irb	M.irb	M.irb	M.irb	Cropping	Cropping	Sedge	Sedge
	Lower slope	Lower slope	Lower slope	Lower slope	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat
	Sample 1 R-L SS1 0-10 cm	Sample 2 R-L SS1 40-50 cm	Sample 3 R-L SS2 0-10 cm	Sample 4 R-L SS2 40-50 cm	Sample 5 R-L SS3 0-10 cm	Sample 6 R-L SS3 40-50 cm	Sample 7 R-L SS4 0-10 cm	Sample 8 R-L SS4 40-50 cm	Sample 9 R-L SS5 0-10 cm	Sample 10 R-L SS5 40-50 cm	Sample 11 R-L SS6 0-10 cm	Sample 12 R-L SS6 40-50 cm
Parameter	N6105/1	N6105/2	N6105/3	N6105/4	N6105/5	N6105/6	N6105/7	N6105/8	N6105/9	N6105/10	N6105/11	N6105/12
Phosphorus (mg/kg P)	4.2	2.5	4.5	2.1	11	2.8	18	4.3	6.5	3.0	5.0	2.5
pH	5.23	5.94	5.17	5.67	6.22	6.83	6.46	7.75	6.28	7.50	6.17	7.26
Electrical Conductivity (dS/m)	0.024	0.011	0.026	0.008	0.043	0.087	0.051	0.763	0.055	0.241	0.072	0.200
Estimated Organic Matter (% OM)	1.3	0.12	1.7	0.09	4.6	1.9	3.2	1.1	4.0	2.8	4.5	2.1
Exchangeable Calcium (mg/kg)	53	41	52	<10	943	420	620	835	2,017	3,334	2,962	3,215
Exchangeable Magnesium (mg/kg)	41	34	34	20	317	401	331	2,051	1,773	2,922	2,583	3,085
Exchangeable Potassium (mg/kg)	<50	<50	<50	<50	112	<50	124	56	156	132	288	150
Exchangeable Sodium (mg/kg)	<15	<15	<15	<15	23	243	88	2,104	280	1,140	379	934
Exchangeable Aluminium (mg/kg)	21	6.6	31	14	2.0	1.1	<1	1.2	2.7	<1	5.0	1.3
Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)	1.4	0.74	1.3	0.59	7.8	6.6	6.6	30	26	46	39	46
Calcium (%)	19	28	20	2.3	60	32	47	14	38	36	38	35
Magnesium (%)	25	37	21	27	33	50	41	56	55	52	55	55
Potassium (%)	5.2	3.1	4.6	3.2	3.7	1.4	4.8	0.47	1.5	0.73	1.9	0.84

Sodium - ESP (%)	3.8	4.3	1.7	4.8	1.3	16	5.8	30	4.6	11	4.3	8.9
Aluminium (%)	17	9.9	26	26	0.29	0.19	0.17	0.04	0.12	0.02	0.14	0.03
Hydrogen (%)	30	18	26	36	1.1	0.00	1.1	0.00	0.44	0.00	0.41	0.00
Calcium/Magnesium Ratio	0.79	0.75	0.94	0.08	1.8	0.64	1.1	0.25	0.69	0.69	0.70	0.63
Total Carbon (%)	0.74	0.07	0.97	0.05	2.6	1.1	1.9	0.63	2.3	1.6	2.6	1.2
Total Nitrogen (%)	0.08	0.02	0.08	0.02	0.16	0.09	0.13	0.06	0.16	0.10	0.20	0.11
Carbon/Nitrogen Ratio	9.4	2.9	13	2.2	17	13	14	11	15	15	13	11
Basic Texture	Loam	Loam	Loam	Loam	Clay Loam	Clay Loam	Clay Loam	Clay	Clay	Clay	Clay	Clay
Basic Colour	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish	Brownish
Chloride Estimate (equiv. mg/kg)	15	7.0	17	5.1	28	56	33	488	35	154	46	128

Table x: Reference Sites - soil nutrient analysis data summary. This table gives the range of values for soil nutrient attributes in topsoil (0-8 cm) and subsoil (30-40 cm) at three sites (Rosedale, Cemetery and Purga NR).

		0-8 cm	**30-40 cm**	**Comment**
Phosphorus (mg/kg P)		2.4 – 7.2	<1 – 1.3	Very low, normal for bushland, higher conc. in topsoil
pH		6.25 – 6.67	4.88 – 6.39	Slightly acid to neutral topsoil, subsoil more acid
Electrical Conductivity (dS/m)		0.040 – 0.068	0.569 – 0.760	Low, much higher in subsoil
Estimated Organic Matter (% OM)		4.3 – 6.9	0.75 – 1.3	Normal*
Exchangeable Calcium	(mg/kg)	1474 – 2313	297 – 1180	Normal, decreases with depth
Exchangeable Magnesium	(mg/kg)	870 – 1034	1034 – 1528	Higher than normal, increases with depth
Exchangeable Potassium	(mg/kg)	86 – 162	<50 – <50	Normal
Exchangeable Sodium	(mg/kg)	164 – 208	995 – 1345	High, increases markedly with depth
Exchangeable Aluminium	(mg/kg)	1.4 – 3.9	1.5? – 126	Topsoil low, subsoil high
Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)		16 – 21	18 – 24	Normal, reflecting % organic mater
Total Carbon (%)		2.55 – 4.02	0.43 – 6.39	Normal
Total Nitrogen (%)		0.15 – 0.26	<0.02 – 0.04	Low, higher in topsoil

* normal refers to indicative guidelines provided by EAL

Table x: Subject Site - soil nutrient analysis data summary. This table gives the range of values for soil nutrient attributes in topsoil (0-8 cm) and subsoil (30-40 cm) in four soil cores collected at the Subject Site, two from swales, two from low rises.

		Swale		**Hill**		
		0-8 cm	**30-40 cm**	**0-8 cm**	**30-40 cm**	**Comment**
Phosphorus (mg/kg P)		4.8 – 5.8	1.5 – 3.8	2.1 – 2.3	2.7 – 3.3	Very low, higher in swale, decreases with depth, similar to reference sites
pH		5.80 – 5.98	4.50 – 4.73	5.20 – 5.62	5.75 – 6.36	Topsoil much the same 5-6, subsoil more acid, swale less acid, ph similar to ref. sites
Electrical Conductivity (dS/m)		0.039 – 0.063	0.404 – 0.535	0.017 – 0.018	0.018 – 0.057	EC of swale much higher in subsoil, EC of hill similar in topsoil and subsoil, swale similar to reference sites
Estimated Organic Matter (% OM)		2.3 – 4.7	0.54 – 0.67	1.5 – 1.8	0.48 – 0.52	Normal*, lower in topsoil on hill, less is subsoil
Exchangeable Calcium	(mg/kg)	421 – 1135	162 – 186	115 – 229	16 – 53	Much higher in topsoil than subsoil, much higher at swale than hill, lower than ref. sites
Exchangeable Magnesium	(mg/kg)	173 – 382	812 – 978	67 – 72	765 – 934	Higher in subsoil, particularly on hill, similar to reference sites
Exchangeable Potassium	(mg/kg)	57 – 143	<50 – <50	<50 – <50	<50 – <50	Normal, fairly constant throughout, similar hill and swale and reference sites
Exchangeable Sodium	(mg/kg)	39 – 41	864 – 988	<15 – 24	2.95 – 5.34	Much higher in subsoil of swale, similar to reference sites, lower on hill topsoil and subsoil
Exchangeable Aluminium	(mg/kg)	2.2 – 8.8	297 – 627	22 – 33	32 – 61	Very high in subsoil in swale, little difference topsoil and subsoil on hill
Effective Cation Exchange Capacity (ECEC) ($cmol_+$/kg)		4.3 – 9.4	18 – 19	2.0 – 2.2	8.7 – 12.0	Higher in swale, higher in subsoil, topsoil lower than reference sites
Total Carbon (%)		1.3 – 2.7	0.31 – 0.38	0.89 – 1	0.27 – 0.3	Topsoil much lower than reference sites
Total Nitrogen (%)		0.08 – 0.15	0.02 – 0.03	0.04 – 0.05	<0.02 – <0.02	Higher in topsoil, lower on hill, lower than reference sites

* normal refers to indicative guidelines provided by EAL

Table x: Recipient Site - soil nutrient analysis data summary. This table gives the range of values for soil nutrient attributes in topsoil (0-8 cm) and subsoil (30-40 cm) in four soil cores collected at the Subject Site, two from swales, two from low rises.

		Lower slope		Flat		
		0-8 cm	**30-40 cm**	**0-8 cm**	**30-40 cm**	**Comment**
Phosphorus (mg/kg P)		4.2 -4.5	2.1 – 2.5	5.0 - 18.0	2.5 -4.8	P much higher on flat, more in topsoil, well below agric. level
pH		5.1 - 5.2	5.7 -5.9	6.2 – 6.2	6.8 - 7.7	Slightly more acid on slope, Similar top and subsoil,
Electrical Conductivity (dS/m)		0.024 - 0.026	0.008 – 0.011	0.043 -0.072	0.087 – 0.762	High in subsoil, much higher on flat, subsoil flat very high (salt?)
Estimated Organic Matter (% OM)		1.3 – 1.7	0.09 – 0.12	3.2 – 4.6	1.1 2.8	Higher on flat, very low on slope, about agric. level
Exchangeable Calcium	(mg/kg)	52 - 53	<10 - 41	620 - 2962	440 - 3334	Much higher on flat (x20), agric. level
Exchangeable Magnesium	(mg/kg)	34 - 41	20 -34	317 - 2583	401 - 3085	Much higher on flat (x20), much higher than agric. level
Exchangeable Potassium	(mg/kg)	<50 - <50	<50 - <50	112 -228	<50 – 150	Higher on flat, more in topsoil
Exchangeable Sodium	(mg/kg)	<15 - <15	<15 - <15	23 - 379	242 - 2104	Much higher on flat, very high in subsoil on flat
Exchangeable Aluminium	(mg/kg)	21 - 31	6.6 – 14.0	<1 – 5.0	<1 – 1.3	Much higher on slope, higher in subsoil
Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)		0.74 – 1.4	0.59 – 1.3	6.6 - 39.0	6.6 – 46.0	Much higher on flat, much higher in subsoil
Total Carbon (%)		0.74 – 0.97	0.05 – 0.07	1.9 -2.6	0.63 – 1.6	Higher on flat and in topsoil
Total Nitrogen (%)		0.02 - 0.02	0.08 - 0.08	0.13 - 0.20	0.06 - 0.11	Lower on slope, bit lower than agric. level on flat

* normal refers to indicative guidelines provided by EAL

Short Term Criteria (to 5 years)
The translocation of each species:
· at least 70% of the transplants and enhancement introductions are surviving after the first year and 60% after five years (and arrangements for replacement from backup stock are underway in case of failure to meet this target);
· germination from freshly shed or soil-stored seed of Hairy joint-grass and Tall knotweed occurs following suitable seasonal rainfall
· flowering and seed production (or spore production) occurs in transplanted individuals (if appropriate to species timeframe and maturity of transplanted material)

· the translocated populations display similar growth development and vigour to naturally occurring populations
· regeneration occurs in transplanted individuals (if appropriate to species timeframe and maturity of transplanted material)
Habitat and threat management:
· good quality habitat restored in and surrounding the recipient site;
· maintenance carried out at suitable intervals; and
· threatening processes including weed invasion controlled or eradicated.
Long Term Criteria (decades)
The timeframe of the current project will not permit the development of slow-growing species i.e. Green-leaved rose walnut to be followed to reproductive maturity. Annual plants however will complete many life cycles in timeframes of a decade or more. Details of long-term criteria are provided for information and adoption where feasible.
· translocated individuals survive to reproductive maturity;
· new seedlings or vegetative offspring are established;
· the number of individuals in the population is sustained or increased by natural recruitment;
· adequate levels of genetic fitness are maintained through generations
· reproduction including the production of flowers and fruit (or spores) and seed viability (spore viability) is consistent with levels in naturally occurring plants;
· natural habitat conditions are restored or maintained at the recipient site.

Generally, the short-term criteria that would apply during the time-frame of the translocation monitoring allow for a decrease of 30% of translocated/introduced plants after one year and 40% after five years (RMS 2015 b, p. 46).