Revegetation case study

(Adding area to woodland using a corridor)

Landscape Goal

Create woodland patches of greater than 50ha to maintain breeding viability of the most sensitive fauna in the medium term (50 years).

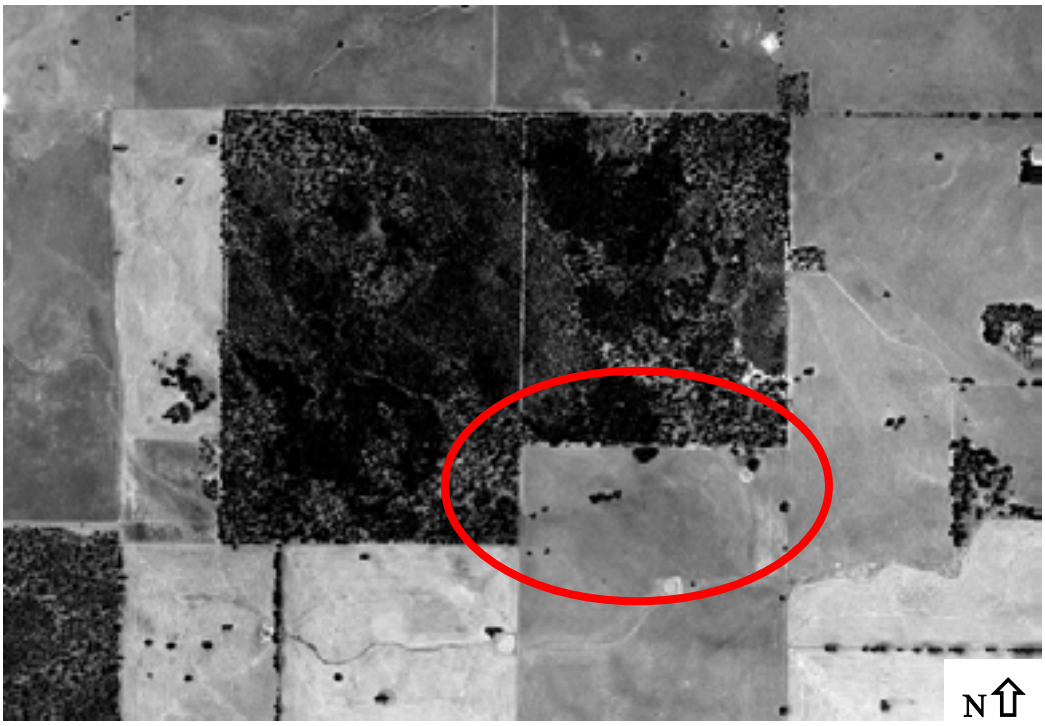
Land manager
(conservation)
OBJECTIVE(S)

Connect two isolated (less than 50 ha) patches of woodland, raising their combined area to greater than 50 ha.

Land manager
(agriculture)
OBJECTIVE(S)

Reduce waterlogging, improve cultivation pattern, protect paddock remnants, and replant natural vegetation associations.

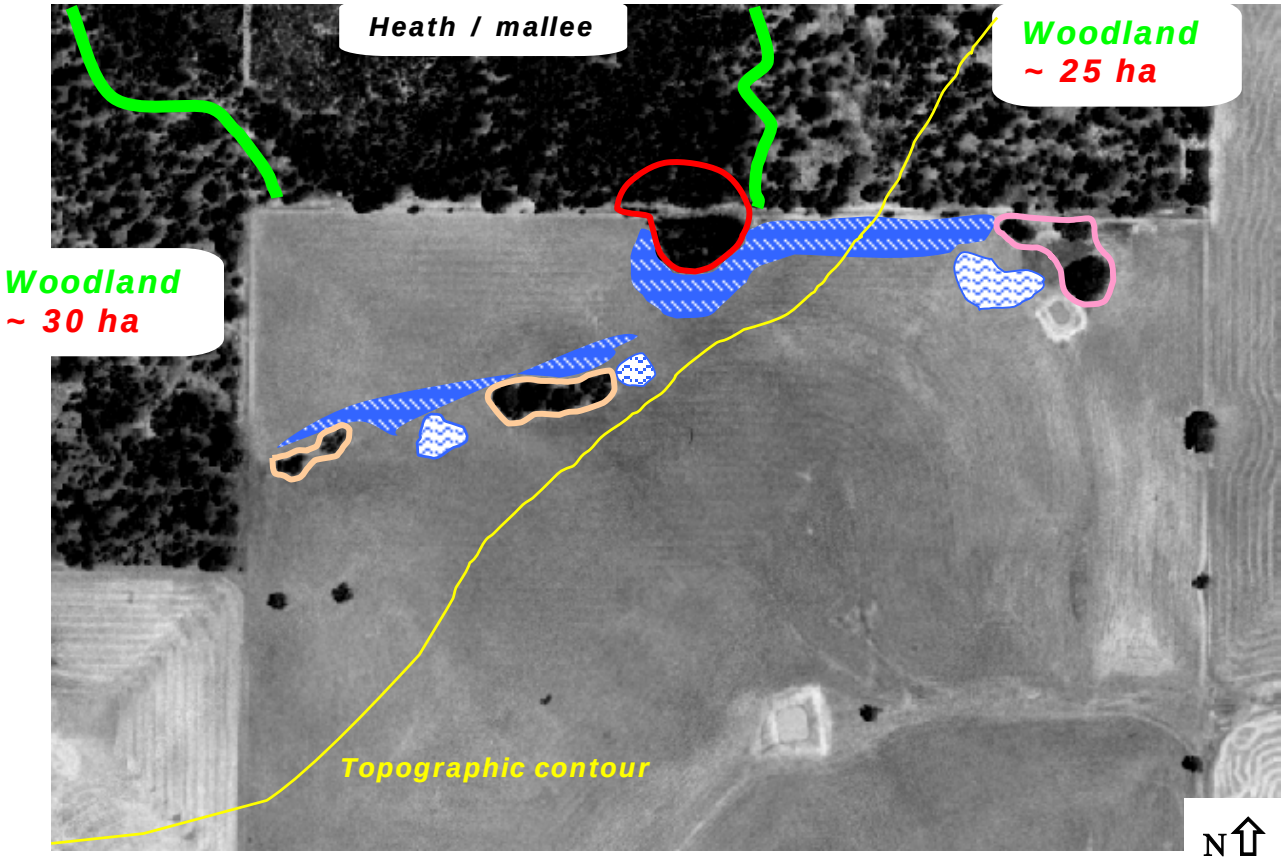
Dongolocking - Central wheatbelt WA



Department of Conservation and Land Management

Bushcare
The National Vegetation Initiative

Site characteristics



1.1 km

Winter waterlogging (water discharge sites)

Woodland

note: isolated areas of woodland, each < 50 ha. Woodland tree species are predominantly *Eucalyptus salmonophloia* (salmon gum), *E. longicornis* (morrel), *E. wandoo* (white gum), and *E. loxophleba* subsp. *loxophleba* (york gum).

Surface water run-off

Eucalyptus loxophleba subsp. *loxophleba* vegetation association with scattered granite rocks

Eucalyptus salmonophloia and *E. longicornis* vegetation association.

Eucalyptus astringens (brown mallet) vegetation association.

Design of revegetation:

Species Selection

Based on the objective of increasing area of habitat via a connection of isolated woodland areas, species selected represent those of pre-clearing native vegetation. This was determined by assessment of on-site fragmented remnant bush and soil types (see page 7).

Characteristics to meet objectives

Nature Conservation Objectives

Increasing area to maintain breeding viability of the most sensitive fauna in the medium term (50 years). - the revegetation links two areas of woodland (30 ha and 25 ha) with a 'habitat' corridor, thereby effectively creating a 55 ha woodland patch. The minimum size to maintain breeding viability of the most sensitive fauna in woodland in the medium term (50 years) for this area was assessed to be 50 ha.

Natural plant associations - eg *Eucalyptus wandoo* with *Hakea lissocarpha*; *Eucalyptus phenax* and *Eucalyptus phaenophylla* subsp. *phaenophylla* scattered throughout *E. wandoo* vegetation association. By using natural plant associations, an appropriate scale of diversity is achieved also, ie diversity is not equally distributed over the whole site.

Nest sites, Shelter, Protection and Nesting material - provided in part by 'habitat patches' or thicket areas. Most native mammals of the south west prefer or require areas of dense vegetation for these purposes. Attracting native animals also forms the basis to the distribution of seed and / or plant propagules from remnant vegetation.

Nest hollows - will be provided by the selection of native overstorey tree species. These may take around 100 – 150 years to develop.

Provenance protection - seed was collected local to revegetation site to ensure protection of local genotypes from inter-breeding with introduced genetic stock.

Vegetation Structure (density) - is based on stem counts in surrounding remnant bush.

Vegetation Structure (form characteristics) - are based on the clumping habit resulting from the interaction of fire, seed fall and seedbed preference for areas of hot burn. A planting pattern based on a 4 m – 2 m – 4 m – 2 m rip line spacing was intended to impose a degree of clumpiness and also variation in form.

Vegetation Structure (layers) - this planting was predominantly overstorey species (large trees and mallees), with a small proportion of small trees and shrubs. The small trees and shrubs were concentrated into thicket style 'habitat patches' (see above) to capture a range of other habitat values.

Buffering of remnant bush - part of the revegetation provides direct protection from wind, spray drift, fertiliser / nutrient movement and weed seed movement.

Incorporation of paddock based remnant vegetation - values associated with including paddock remnant vegetation, regardless of size include: provision of age structure to the vegetation, provision of a potential source of 'small fauna' eg invertebrates, and capturing unique sources of plant and animal genetic material (diversity).

Contour planting to increase habitat value - in addition to contour ripping to

minimise erosion, planting on the contour was considered to facilitate retention of litter within the site, especially in the event of a rainstorm.

Ecosystem process objectives

Level of diversity - as many species as was practical were planted. Species generally had to have accessible seeds and be easily mass propagated. It was generally expected that the initial level of diversity, together with species density will strongly influence successional patterns of the revegetation. The major deficiency in the species mix at this site (as will be all other agricultural revegetation) is the resprouting understorey component.

Nitrogen fixing plants - with a paddock history of cereal cropping and sheep grazing, it was considered that nitrogen would not be a limiting nutrient to plant growth. Nitrogen fixing plants were therefore concentrated within the 'patches' of revegetation.

Nutrient cycling plants - evidence indicates that early successional species generally have more nutrients in their falling leaves. For example, *Acacia* spp. are generally known to relocate less nutrients from their phylodes/leaves before dropping than *Eucalyptus* spp. Nutrient levels and rate of decay (residence time) of litter is also considered to be positively correlated, aiding in the establishment of ecosystem functioning attributes. Plants from the Mimosaceae, Caesalpinaceae, Casuarinaceae and Fabaceae families are suitable. Preferred litter producers and nitrogen producing species, not surprisingly, (being attributes of pioneer or early successional species), are from the same plant families and forfill a multifunctional ecological role.

As for nitrogen fixing plants, nutrient cycling plants were concentrated within the 'patches' of revegetation. Availability of landholder time was the most limiting factor to increasing the number of patches and their extent. In addition, many of the nitrogen fixing and nutrient cycling plants are poisonous to agricultural stock and were unaccepted by the landholder for inclusion.

Replacability / stability - Fire appears to be the primary threat to replacability. Accessing the primary regeneration techniques (ie seeders and resprouters) that plants employ assisted with determining species replacability / stability. The proportion of seeders to resprouters of wheatbelt vegetation appears to flux at the 25-40 % level (Kingsley Dixon pers. comm. 1999). Evidence on the ecological role of seeder**:**sprouters (ie species that can regenerate from seed and resprout, eg *E. wandoo, E. loxophleba*) indicates that this particular life form has increased ecological 'fitness' in conditions of irregular fire events (a likely farmland revegetation scenario), eg combinations of periods of short fire intervals (15-25 years) and periods of long fire intervals (>30 years). This particular planting has a seeder**:**sprouter composition of 75 % with the balance accounting for seeders and obligate seeders. Note that *Acacia acuminata* has been identified as a seeder. This is its primary regeneration method however, it does have the ability to resprout (see page 7).

The seeder and resprouter composition of the revegetation represents a mix of species that have accessible seeds and can be mass propagated. Diversity of these mechanisms also gives the revegetation as a whole, the capacity to withstand environmental extremes.

Hydrological issues - revegetation targets areas of 'change in slope', recognised as being key areas for revegetation to access and use ground water and also targets a series of areas suffering from winter waterlogging.

Agricultural land use objectives

Reducing waterlogging - revegetation was located on and directly upslope of seasonally waterlogged areas.

Consistent with contour cultivation - orientation of revegetation boundary allows for a dramatic improvement in paddock cultivation pattern.

Protection of paddock remnant bush - four separate unprotected areas were incorporated into the revegetation.

Replant natural vegetation associations - importance was placed on maintaining a natural appearance by the agricultural land manager. Attention was therefore placed on planting natural vegetation associations and matching different vegetation associations with changing soil types.

Minimising of competition with paddock production - *Eucalyptus loxophleba* subsp. *loxophleba* (york gum) was used as a border species. This species has been observed to compete less with adjoining areas than *Eucalyptus salmonophloia* (salmon gum) and *Eucalyptus longicornis* (red morrel).

Stock protection - orientation of revegetation boundary allows for stock protection from all possible directions away from remnant bush boundary.

Establishment:

Seeding method - seedlings were selected in preference to direct seeding. This decision was based on the necessity to plant in the year of planning and the use of herbicide for weed control (direct seeding requires one year in advance herbicide weed control). In addition, reliability of successful establishment is many times higher using seedlings than for direct seeding in this area.

Contour ripping - as the site was sloping (about 2.5 % grade), contour guide lines were surveyed about every 50 m for ripping. Ripping was performed with a single tine trailable ripper to a depth of 40cm and was completed in early July. Rip line spacing followed a pattern of 4 m – 2 m – 4 m – 2 m. The contour ripping was also essential to prevent erosion from surface water run-off from the bare site after blanket herbicide weed control.

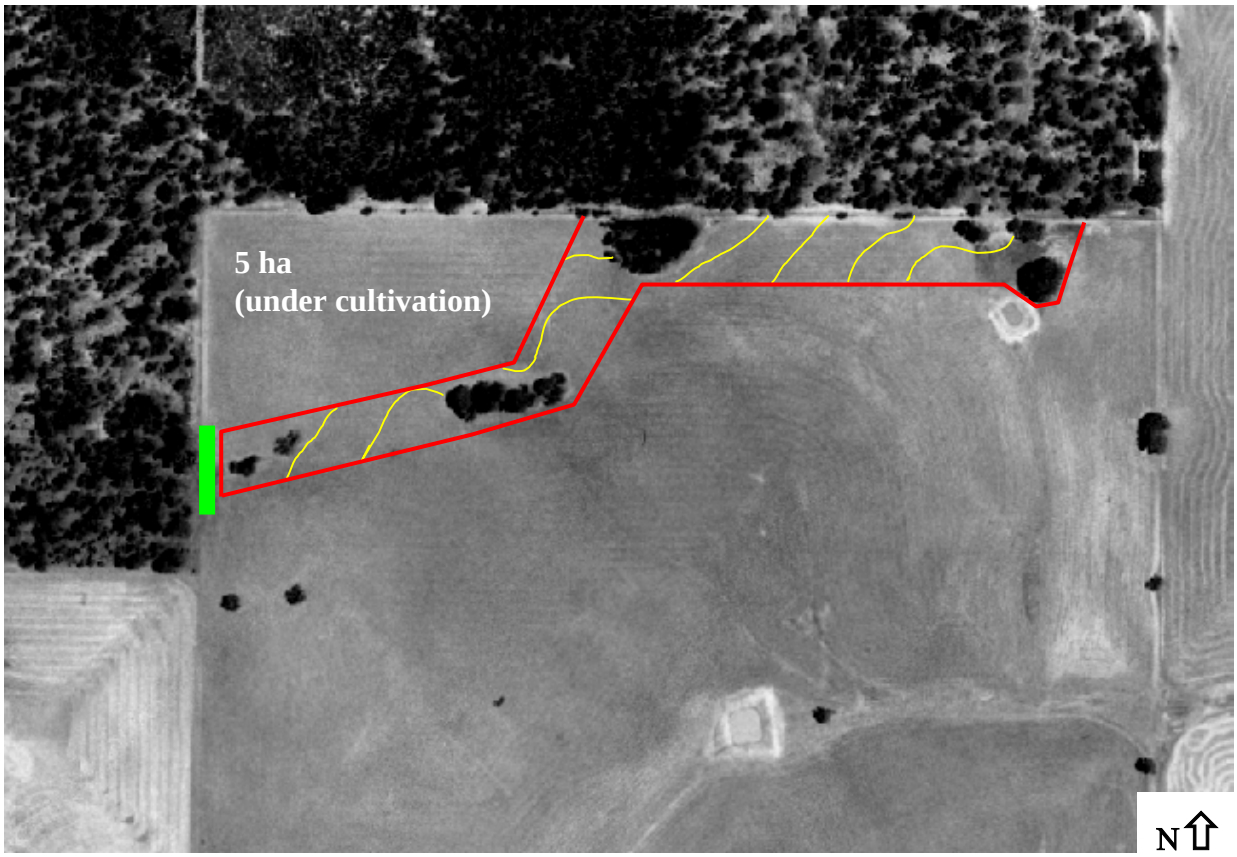
Weed control - the site was blanket sprayed with 1 L of glyphosate per ha and 3.5 L of simazine per ha in mid July. This spraying date is later than normally recommended, however, it allowed for excellent control of late germinating weeds.

Planting boundaries pegged before planting - natural vegetation boundaries were assessed and predicted before planting. These boundaries were clearly marked with pegs allowing for the planting operation to run smoothly and for the revegetation to represent irregular natural boundaries.

Planting method - 'pottiputki' hand planters were used. Seedlings were directed slightly to one side of the rip line to minimise the risk of direct contact with concentrated herbicide in the central part of the rip line.

Preparation and planting of 'habitat patches' - these areas were cultivated with a scarifier (two passes) prior to herbicide weed control. Dimensions were about 16 m x 12 m per patch. Each patch was planted to a single species (small tree or low shrub) at 1m spacing to create a thicket effect.

Layout of revegetation:



1.1 km

Area: 5.2 ha in total. **Width:** 40 – 50 m.

= Revegetation boundary

= Guidelines for contour ripping

Contour ripping pattern = 4 m 2 m 4 m 2 m ….to give clumped effect.

= Access (vehicle / machinery and stock)

Species selected for revegetation:

Species	Common name	Spacing (m) / location	[1]Seeder / resprouter
Acacia acuminata	jam wattle	Patch / scattered	Seeder
Acacia microbotrya	manna gum	3	Seeder
Acacia saligna	golden wreath wattle	patch	Seeder
Allocasuarina huegeliana	rock oak	patch	Obligate seeder
Hakea prostrata	harsh hakea	patch	Seeder and lignotuberous resprouter
Hakea lissocarpha	honeybush	scattered	Seeder and lignotuberous resprouter
Melaleuca uncinata	broom bush	patch	Seeder
Eucalyptus longicornis	red morrel	4	Seeder and epicormic resprouter
Eucalyptus loxophleba subsp. *loxophleba*	york gum	3	Seeder, epicormic resprouter and lignotuberous resprouter
Eucalyptus astringens	brown mallet	3	Obligate seeder
Eucalyptus phenax (previously *E. anceps*)	kangaroo island mallee	3	Seeder, epicormic resprouter and lignotuberous resprouter
Eucalyptus phaenophylla subsp. *phaenophylla*		4	Seeder, epicormic resprouter and lignotuberous resprouter
Eucalyptus salmonophloia	salmon gum	4	Seeder and epicormic resprouter
Eucalyptus wandoo	white gum	3	Seeder and epicormic resprouter

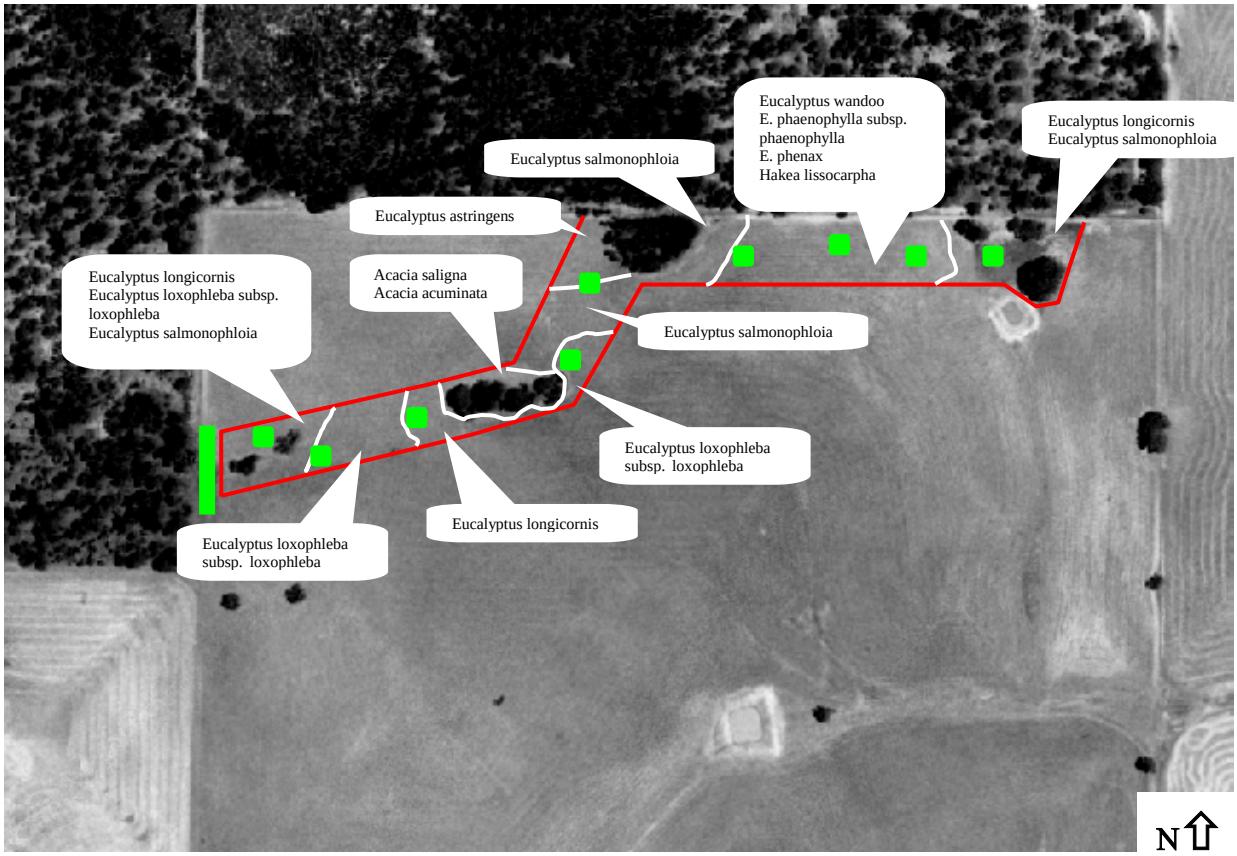
[1]Seeder / resprouter = how it regenerates, including its response to fire.

Note: seeder / resprouter refers to the main form of regeneration. For example, many of the seeder species can resprout to some degree. Obligate seeders however, are those plants that depend solely on seed for regeneration. For more information see heading: Replacability / stability.

Seedling density at 3 m (along row) intervals = 1 000 plants per ha.
Seedling density at 4 m (along row) intervals = 750 plants per ha.

About 6 000 seedlings planted

Species distribution:



White lines indicate planting boundaries (these were marked with pegs and survey tape prior to planting).

Patches

■ = 'habitat patches' cultivated with scarifier after ripping. Patches are about 16 m x 12 m. Each patch planted to a single species (small tree or low shrub) at 1 m spacing to create a thicket effect.

Species used in each patch (from west to east)
1. *Acacia acuminata,* **2.** *Allocasuarina huegeliana,* **3.** *Acacia saligna,* **4.** *Hakea prostrata,* **5.** *Acacia acuminata,* **6.** *Acacia acuminata,* **7.** *Melaleuca uncinata,* **8.** *Melaleuca uncinata,* **9.** *Acacia acuminata*

Opportunities

Patches of *Acacia acuminata* can serve as sandalwood host trees in the future.

Success of revegetation:

- *Seven month old seedlings (March 2000).*
- *Survival was 96 %.*
- *Excellent weed control assisted with establishment success.*

Revegetation on eastern section representing a wandoo woodland vegetation association adjacent to priority remnant bush.

One of nine 'habitat patches'. This patch *is Acacia acuminata*. Background is of protected paddock remnant bush.

The foreground shows an *Acacia saligna* 'habitat patch'. Background shows western end of revegetation and link with priority remnant bush.

A 'habitat patch' of *Hakea prostrata*.

Monitoring:

Establishment

Establishment success - plant counts and general health of seedlings.

Management

Weed cover and type - monitor during the year of planting including the first summer and second year.

Outcomes

Nature conservation

Fauna utilisation of site - Monitor focal species birds utilising site and / or other fauna.

Photo monitoring sites - these are intended to be a visual representation of ecosystem development.

Agriculture

Water use - monitor revegetation growth rates as a measure of water use.

In Brief – Cost of establishment per ha (2000)

Materials and activities required for establishment	**Options ($ per ha)**	**[1]Totals**
6000 seedlings @ 34c each.	$453	
Ripping – 3PL tractor ripper.	$60	
Weed control using 1 L glyphosate and 4 L of simazine per ha.	$30 + contract spray rate or wear and tear on own machinery.	
Planting @ 10c each (contract rate).	$133	
Fencing @ $1240 per km (materials only) + construction cost.	Different for each site.	

[1] Totals are left blank intentionally. This is to allow for individual choice of options.

In Brief – multiple objectives achieved

Nature conservation	❖ Increased area of natural habitat that meets the minimum size for maintenance of breeding viability of the most sensitive fauna. ❖ Incorporated natural plant associations. ❖ Maintained local provenance protection. ❖ Protection given to paddock remnant bush. ❖ Contour ripping to facilitate retention of litter. ❖ Thicket areas provided to increase habitat value. ❖ Buffering of priority remnant bush ❖ Planting pattern designed to impose clumpiness and thus increase habitat value.
Ecosystem processes	❖ Level of diversity (given practical constraints) represents a best bet compromise. ❖ Stability / replacibility of system accounted for. ❖ Increase in water infiltration where it falls and a future substantial increase in water use.
Agricultural land use	❖ Reduction of surface water run-off. ❖ Reduction of winter waterlogging. ❖ Reduction in recharge and thus, ground water pressure head on productive agricultural areas. ❖ Complementary to contour cultivation of paddock ❖ Stock protection. ❖ Border species (york gum) used to minimise competition with surrounding land use.

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