



North Stirlings and Pallinup River Catchments

REVEGETATION GUIDE



Restoring biodiversity values on farmland through
direct seeding and seedling plantings

BY WENDY BRADSHAW AND GEOFF WOODALL

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INTRODUCTION

Resilient farm ecosystems are vital for sustainable productivity and therefore profitability. Resilient farm ecosystems are a product of high levels of biodiversity.

Biodiversity is an all-inclusive term that includes interactive processes between the physical environment and living things.

It is about life, death and decay at genetic, species and ecosystem levels and is not just what happens in nature reserves!

PHOTO - Mixed plantings of alleys of biodiversity plantings provide windbreaks, stabilisation of creek-lines and habitat for beneficial species such as predatory invertebrates, insectivorous birds and pollinators. A combination of forage shrubs with perennial pastures in a paddock (towards rear of photo) has boosted production on a hillside seep that was turning into a salt scald.

Biodiversity provides stability of ecosystem function and therefore resilience to farming landscapes. A diversity of woody and herbaceous perennial plants adds stability to landscapes dominated by annual crops and pastures. They provide habitat for beneficial fauna that together help maintain ecosystem services such as soil formation, provision of food and shelter, pollination, cycling of nutrients, pest management, hydrological balance, a lovely place to live and much more.

A 'backbone' of native vegetation provides habitat for wildlife and adds resilience to farm ecosystems. Some might say that it just adds more 'roos', rabbits and foxes. And this is certainly likely: these are issues that need to be managed. The bigger picture is the health of the farm ecosystem and the farmer's vision for how they would like it to be now and in the future.

Resilience supported by biodiversity enhances the farm's capacity to buffer the damaging effects of disturbance such as storms, droughts, frosts, floods and plagues. Successful revegetation produces self-sustaining systems that have all of the key structural and functional elements necessary for successional processes to occur effectively.

This guide aims to provide methods as well as species guides that include key structural and functional elements of native vegetation communities of the mid-upper Pallinup River and surrounds. Vegetation communities are linked to associated soil types and landscape positions.

The capacity of the restoration work to evolve over time is enhanced by being linked to existing bushland, which enables more flora and fauna species to move around the landscape. An effort has been made to include a range of key species listed in the vegetation communities that are currently able to be grown from seed and / or seedlings.

SEED OR SEEDLINGS?



The revegetation of poor quality agricultural land is achieved by the planting of nursery raised seedlings and / or sowing native seeds (direct seeding). The direct seeding of native plants is now a reliable establishment technique, provided there is adequate practitioner competence and access to appropriate equipment. Technological improvements in both seeding equipment and native plant agronomy have led to improved reliability and uniformity of direct seeding. Some species, for one reason or another, should still be planted as nursery raised seedlings / rooted cuttings (e.g. *Adenanthos* and *Lambertia* species).

The technique of direct seeding can readily establish plant densities of 1000-5000 plants per hectare, which is ideal for creating structurally complex vegetation. Direct seeding can be a cheap establishment technique (as low as \$500 per hectare) but for most operators it has a higher risk of failure than the planting of nursery raised seedlings that are far more expensive to establish.

While robust systems and improved equipment have been developed, the main obstacle to reliable establishment is the fact that direct seeding of native seed requires a much higher level of competency than that required to plant a nursery raised seedling. The important factors that determine the success of a direct seeding operation are:

- » *practitioner competency*
- » *selecting the most appropriate sowing method, equipment and setup of equipment*
- » *understanding species suitability to proposed site*
- » *moisture management*
- » *appropriate pest and weed control*
- » *understanding site conditions (soils [pH, chemical history, and fertility], climate, land use history, pests and diseases, etc)*
- » *timing*
- » *germination characteristics and niche requirements of species*
- » *sowing depth*
- » *seeding rate and species mix*
- » *seed quality*
- » *seed preparation (breaking dormancy, inoculants)*

Practitioner Competency

People who are interested in the local flora are encouraged to develop skills in this plant establishment. It can take many years to develop reliable establishment skills and during this learning phase it is recommended that practitioners use direct seeding coupled with the planting of nursery raised seedlings to establish sites.

Often large numbers of species are involved, with highly variable seed size and shape, contrasting germination requirements and factors that can influence success or failure. For those people who are not interested in the local flora / revegetation it is recommended that appropriate people with expertise be used to provide technical assistance or contracting services.



Diverse understorey species will create better habitat than dense stands of trees that outcompete understorey. Prickly shrubs such as *Hakea prostrata* (left foreground) and *Hakea corymbosa* (round bush to left rear), as well as bushy shrubs such as one-sided bottlebrush *Calothamnus quadrifidus* (rear left and right understorey) provide habitat for small birds and beneficial predatory insects.

Planning for revegetation needs to be undertaken in context with the objectives of the landholder and whole-farm planning. A few examples of objectives might be to stabilise soil such as salt scalds or gutless sands, to create linkages with existing bushland and habitat for beneficial fauna such as insectivorous birds, bats and predatory insects and possibly for fauna that you wish to attract back to your property, to make the place look and feel great!

If targeting specific fauna such as small mammals, dense understorey will be needed. Stages of planning for revegetation include site assessment, organising resources to undertake the work, including seed and / or seedlings, machinery, funding and labour, and how to monitor achievement of objectives.



Where soil type and landscape position is suitable, revegetation that includes species such as banksias and hakeas can provide endangered species such as Carnaby's Cockatoo valuable additional food sources. Cockies are shown here feeding on *Banksia mucronulata* located on a gravel ridge west of Tambellup.



Information gathered at the site assessment informs revegetation design including site preparation, species selection and quantities of seed and / or seedlings, planting techniques and design, and threats to successful outcomes such as water-logging / salinity, rabbits, kangaroos and weeds. It is also a good time to consider necessary monitoring processes that track progress to achieve objectives and identify actions that need to be taken to address threats.

When visiting site, ensure boots and equipment are clean prior to entering and leaving site to prevent spread of disease such as dieback (*Phytophthora cinnamomi*). See page 13 for information on hygiene protocols.

It is useful to have an aerial photograph showing site and adjacent landscape features / habitats such as remnant vegetation, wetlands, and existing fencing; a pick or shovel to check out soil type; and a camera to take reference photos.



Before and after photos are valuable for monitoring change following revegetation activities.

COLLECT THE FOLLOWING INFORMATION FROM SITE AND DESKTOP ANALYSIS

- » Objectives of the planting, including expected timing of planting
- » Location of site (with GPS coordinates to mark boundaries)
- » Landform and associated rocks if visible (e.g. granite outcrop, riparian, sand plain)
- » Soil type and colour of top-soil and sub-soil (sand/loamy, sand/clayey, sand/sandy, loam, loam/clay, loam/sandy, clay/loamy, clay/clay, with or without gravel), approximate depth of topsoil
- » Map different soil types
- » Condition of soil (e.g. compacted, % ground cover and type, evidence or threat of wind or water erosion) and hydrological features (e.g. water-logging, salinity, non-wetting)
- » Vegetation type (ie. the tallest dominant species that is known to grow on that soil type and landscape position e.g. flat-topped yate (*Eucalyptus occidentalis*))
- » Previous land use (e.g. grazing and fire history)
- » Paddock fertiliser and herbicide history
- » Are there factors that prevent the original vegetation being re-established (e.g. altered nutritional status, site now salt affected, altered soil pH)?
- » List weeds observed and abundance
- » An inventory of resources available for achieving objectives (e.g. identify matching vegetation type in bushland nearby that can be used as seed sources; machinery; labour; funding)
- » Methods of weed and pest control, preparation and planting technique
- » Once area to be revegetated is finalised, estimate the area to be revegetated to calculate quantities and cost of revegetation
- » Take before photos from a spot(s) that can be easily replicated later as a minimum monitoring and evaluation tool

SPECIES SELECTION



Sea rush *Juncus kraussii* thrives with upwelling of water in salt scald planted 1997 (left) showing recruitment 2012 (centre and right).

- 1 » Match the vegetation type identified in the site assessment process with the appropriate vegetation community listed at the end of this guide. It is emphasised that these lists are a starting point to guide the use of local species.
- 2 » Be sure to include the different layers of vegetation that occur with the target vegetation type e.g. Flat-topped yate woodland with bottlebrushes, paperbarks and rushes on winter waterlogging-prone soil.
- 3 » Include pioneer and coloniser species. Pioneer species are those that come up, often in large numbers after disturbance (such as fire), grow quickly, produce lots of seed and litter, and usually put nitrogen in the soil - and are often short-lived. That is, they set up the conditions for the long lived coloniser species that are slower growing and longer lived to establish. Examples of pioneer species are wattles (*Acacia* species), peas (eg. *Bossiaea*, *Kennedia*, *Senna*), native hibiscus (*Alyogyne*) and sheoak (*Allocasuarina*).
- 4 » Select a diverse mix of species in the lower, middle and upper storey to maximise habitat values (e.g. asynchronous flowering times, flower shapes and plant forms such as prickly, bushy, etc.) and resilience of the vegetation to be self-replacing over time (e.g. seeders and sprouters). Tree seedlings < 25% of overall planting with low, mid and tall shrubs, herbs, grasses and / or rushes making up the remainder. For information on seeding rates and mixes, see page 11.
- 5 » Seed collected from species in stands with large populations (more than 100-200 plants) will result in the highest quality revegetation sites. When this is not possible, seeds from smaller populations should be combined to ensure that newly restored populations have high genetic diversity. As a general rule, source seed from stands as close as possible to the revegetation site.
- 6 » Include spreading ground covers that protect the soil and trap water and nutrient runoff, thus reducing soil erosion, sedimentation and pollution of watercourses. Examples are rushes and sedges for creeklines / wet areas (e.g. *Juncus kraussii*, *Ficinia nodosa*, *Juncus pallidus*), low spreading shrubs and ground covers such as some *Acacia*, *Kennedia*, *Brachysemsa* species (now officially included with *Gastrolobium* genus but don't contain 1080), native pigfaces (*Carpobrotus* and *Disphyma*), and native grasses (e.g. wallaby grass, kangaroo grass, weeping rice grass and rush grass *Austrostipa juncifolia*).

SITE PREPARATION



- 1 » Retain old and large trees, dead or alive, as much as possible. They are important habitat for birds of prey which help control pests such as rabbits and mice, and bats to assist with insect pest management. Insectivorous bats eat up to twice their weight in insects every day.

Logs should also be retained because they provide homes for small mammals such as echidnas, as well as reptiles and invertebrates. If logs are obstructing planting routes, they can be pushed out of the way but not burnt.

- 2 » Waterlogged and / or salt affected should be mounded. If mounding in a separate pass to planting, mound in summer / early autumn to allow settlement and germination of weeds prior to planting.

Once mounded, don't allow stock onto mounded area or will damage the mounds. If grassy will need scarifying or scalping prior to mounding or will be cloddy and make poor mounds. Spray mounds after grasses have established on mounds, prior to planting.

- 3 » On rocky, difficult to access sites, a non-standard direct seeding approach might be required; seek technical assistance for these sites. Alternatively, deep ripping with a 3-point linkage ripper and spraying rip lines with appropriate herbicide might be the best option in preparation for planting seedlings with a pottiputki (hand-held tree planter).



Woody debris including hollow logs are important to keep as trap soil, litter and seeds and provide habitat; helping to crank up 'islands' of ecosystem function in degraded lands.



Mounding is needed on waterlogging-prone and saline soils. Contact NSPNR or the Gillamii Centre for availability of mounds.



Gen Harvey (Gillamii Centre) and Penni Hewett (South Coast NRM) planting seedlings into seeded soil using pottiputkis available from the North Stirlings Pallinup Natural Resources (NSPNR).

MACHINERY AND APPROACH



Broomehill farmer David Kinsey direct seeding with Chatfield Tree Planter with precision seeding attachment available from NSPNR.



Chatfield Tree Planter available from Gillamii Centre drops seed on soil surface. Heavy chain aiming to cover coarse seed and fine chain to cover fine seed.



CommVeg seeder enables optimal seed placement, which is critical on light sandy soils that are unable to retain moisture around the seed. For more information contact NSPNR.

A common tree planter that is fitted with a small seeds box can be used to direct sow native seeds (e.g. a Chatfield Tree Planter). Such equipment can be used to scalp 50mm of topsoil (to remove weed seeds), make a shallow rip (20-30cm deep), and scatter seed on the freshly disturbed soil.

It is advisable to drag a steel chain (or something similar) behind the machine to ensure shallow soil coverage over seed. This approach can be somewhat unreliable, deliver a non-uniform result and can be dramatically improved by modifying the machine so that the seed is placed in a stable soil environment at a precise depth.

Modified agricultural seeders can also be used to sow native plants, particularly native legumes (*Acacia* and *Kennedia*) and grasses. Proponents should however seek professional guidance as the sowing of natives is somewhat different to cereal crops and pastures.

While it might seem desirable to sow very quickly with a large modern air-seeder, the results are usually not as reliable as that achieved with machinery purpose built for native plants (modified tree planter or a purpose built native plant seeder such as a CommVeg seeder).

Agricultural machinery does a very poor job of sowing species such as many *Melaleuca* and *Eucalyptus* species. Higher seeding rates (double rates) should be used when seeding with standard agricultural machinery as this partially offsets lower seed use efficiency.

A local, purpose built, native plant seeder, the CommVeg seeder, is available. Contact your local NRM office to arrange hire. This machine can be used to scalp, rip and sow 1-3 lines per pass. On mounded wet sites it can be used to sow seeds on the top of tall mounds. Seedlings can either be planted by hand, with a pottiputki, or from the back of a Chatfield Tree Planter.

PLANTING DESIGN



Unless planting on fragile non-wetting sand, row spacings can be around 2.5m centres. Allow room to get over with a machine for follow up applications for control of insect pests or post-emergent weed control in the following year after planting. It is ideal to get as many rows in as possible and practical to maximize the cover of native vegetation.

On light fragile soils, 4m row centres are recommended and avoid aligning planting rows with the prevailing wind direction to minimise the risk of soil erosion. Do not scalp downslope on sandy soils. It is recommended to plant on the contour where possible in non-water-logged sites to enable water to be retained on site. Along waterways, where practical, mound at 45° to the direction of water flow to allow drainage of water to the watercourse and minimise the risk of erosion from flood events.

Plant spacings within rows will depend on methods used and budget available. If direct seeding and seedlings, it is expected that 5m seedling spacings would be adequate unless difficult conditions. Direct seeding is unsuitable for heavy clay soils and seedlings can be planted 1-2m apart. On salt scalds, direct seeding can be successful on mounds but it is a good idea to supplement with seedlings of species such as fiery bottlebrush (*Callistemon phoeniceus*) that can't cope with high salinity levels when germinating.

Established plant densities can be much higher when direct seeding than seedlings only. When all layers of vegetation are planted / seeded, it is not unrealistic to expect >4,000 stems/ha. To give a comparison with native bush regeneration 12 months post fire, over >40,000 stems/ha (including grasses) were recorded in a brown mallet *Eucalyptus astringens* woodland and >100,000 stems in a wandoo woodland east of Tambellup⁵.



Planting across a slope provides windbreak as well as linking up two remnants at each end (left 2000, right 2006).



Native hibiscus *Alyogyne huegelii* is an example of a pioneer species that grows quickly, produces lots of seed, and is short-lived.

Ground cover running postman *Kennedia prostrata* (foreground) grow well from seed on gravelly soil.



Weed control should be targeted while weeds are actively growing and before flowering to prevent weed seed set. If the site is near a wetland or waterway, it is preferable to use Roundup Bioactive® instead of Roundup® that contains surfactants that are known to damage frog development and can lead to decline or even loss of such fauna species¹. Alternately use a higher rate of glyphosate that doesn't contain surfactants; added spray-grade ammonium sulphate is suitable.

On previously cropped land and most pasture sites, an application of glyphosate 1-2lt/ha (450g/lt) with bifenithrin and 0.5-1.5kg/ha of Simazine® (900g/kg) applied to the site 3-4 weeks prior to establishment should deliver excellent control of pests and weeds. The scalping of the soil during seeding should remove residuals. On white-grey sandy sites do not use more than 0.5kg/ha of Simazine® (900g/kg).

There are no simple 'rules of thumb' for using herbicides and especially residual herbicides. Use of residual herbicides for weed control provides prolonged protection from weeds in the year of planting but needs to be considered in light of the following factors to prevent accidental plant deaths²:

- » **SOIL TYPE** - residuals such as Atrazine® and Simazine® are normally kept out of the root ball of seedlings because residuals bind with soil particles. However, they may not bind to coarse sands (e.g. river sand) and therefore may unexpectedly be found to leach into the root zone of the seedlings on these soils with adverse effects on plantings.
- » **pH** - residuals such as Ally® break down quickly in acid soils but don't break down in alkaline soils. Ally® can be used if needed for certain weeds that glyphosate alone may not provide adequate control such as: dock, sorrel, clover, erodium (corkscrew), sour sob and four o'clock. It is applied before sowing seed or planting seedlings provided there has been 25-50 mm rainfall and at least two weeks have elapsed since spraying on acid soils only.
- » **WHAT IS BEING PLANTED** - soluble residual herbicides are unsuitable for seed or seedling plantings unless targeted at species that aren't being planted such as grass selectives that can be used the year after planting such as Fuselade®, Verdict® (ie. when grasses haven't been planted!) and Taskforce® for African love grass.
- » **METHOD OF PLANTING** - don't spray weeds prior to mounding as the chemical will be bound up and concentrated in the mounds and cause problems for seed or seedling survival. Spray after mounding but only seedlings can be planted if insoluble residual herbicides used unless scalping off topsoil to remove chemical from the root zone of germinants.
- » **WHETHER PLANTING BY SEED AND / OR SEEDLINGS** - as a general rule, direct seeding can be carried out where insoluble residuals are used providing the top-soil is scalped off. Seedlings where insoluble residuals are used don't need to have the topsoil scalped provided mechanical methods of planting are used where the topsoil containing the chemical isn't squished in around the root ball.
- » **RAINFALL** - in addition to the above points, the potential action of leaching of chemical into the root zone of establishing seed germinants / seedlings needs to be considered in context with the method of planting. For example, Simazine® is safe for most seedlings when planted on mounds but if on flat ground and seedlings are planted into a rip line, chemical can be washed into the rip line where it is concentrated and filters down to the root zone and kills off seed / seedlings.

Good references for herbicide information include **Herbiguide** available online at herbiguide.com.au or **Southern Weed and Their Control** by John Moore and Judy Wheeler (2005), available from Department of Agriculture and Food WA (DAFWA).

Rabbits and excessive kangaroo numbers need to be managed prior to, during and after planting to ensure the survival of the planting. Where rabbits are a big problem on deep sands, fencing with rabbit netting might also be needed to achieve successful establishment. A number of Farmnotes on rabbit baiting are available from the DAFWA⁴. Assistance may also be available through the Red Card for Rabbits & Foxes program which may be accessed by contacting your local Landcare Office or South Coast NRM.

Most of the insect pests that cause damage to newly emerged crop and pasture plants also damage native plants, particularly at the cotyledon to six leaf stage. Preventative applications of insecticide are strongly recommended when direct seeding is used.

For example *Acacia*, *Atriplex*, and some eucalypts are extensively damaged by red-legged earth mite (RLEM). Many *Melaleuca* species (eg *M. hamata*) are not damaged by RLEM. Beetle larvae, Rutherglen bugs, weevils can all cause extensive damage to native plants before and after emergence and through to the several leaf stage. Locusts, wingless grasshoppers, beetles, weevils and Rutherglen bugs cause damage after germination, during the following spring-summer.

Seedlings of all species become resistant to RLEM damage once they have reached the 6 leaf stage and thus nursery raised seedlings are not normally damaged by RLEM. Controlling RLEM is usually not required for seedling only projects.

Adding insecticides into the weed control spray mix delivers good results. Adding, for example, bifenithrin and glyphosate together to control insects and weeds 21-28 days prior to sowing is highly effective. A follow up application of insecticide is usually required 2-10 weeks after sowing, depending on the results of the initial insect control.



Spiny rush Juncus acutus shown in this photo is a nasty weed easily distinguished with stiff needle-sharp tips and fan-shaped foliage is easily removed while in low numbers by digging out. Rapidly regenerates and completely covers an area, eliminating all other species and becoming impenetrable to humans and stock³. Grows on wet areas including saline sites.



Good weed control prior to direct seeding and seedling plantings is preferable to relying on post-emergent selective weed control strategies, and provides the opportunity for bare-earth residual insecticide application to protect direct seeding germinants from red-legged earth mite predation.

A seeding rate of about 0.5 kg per hectare for experienced practitioners is recommended; on difficult soils or for practitioners with little experience at a rate of 700-800g is recommended. In many cases (but not all), biodiversity mixes contain approximately 200-300g/ha of leguminous species, 200-300g of myrtaceous species and the remaining is made up of other species.

General rule of thumb for the seeding rates for trees (e.g. yate, flooded gum, jarrah, marri) is <150g/ha, mallees and melaleucas also <150g/ha, and rock sheoak (*Allocasuarina huegelliana*), that has very high seed use of efficiency, at <5g/ha.

Seed is normally mixed with bulking agents (e.g. fine spongelite, fine vermiculite). These additives increase the total volume of material to be sown and improve the metering (spread) of seed over a site and also assist the movement of seed through the cogs of a seedbox. Usually seed is mixed with bulking agent to form a final volume of 1-3 litres/km of row to be sown.

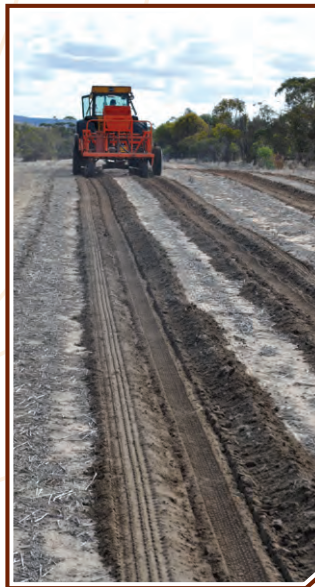
Fertiliser can be added to this mix but it is desirable to keep and sow fertiliser separately. Approximately 1-10kg of fertiliser can be sown or spread with the seed. It is important to use a low or no phosphorous fertiliser when proteaceous species (e.g. banksias and hakeas) are sown.

The seeder must be calibrated to deliver the desired amount of seed / bulking agent mix. Aim for 100-200ml of mix/100m of sowing line. To calibrate, simply take off one seed tube from the seed distributor, tie on a plastic bag, travel 100-200m with the drive wheel engaged, take off the bag and measure the volume of the mix in the bag. Use this information to determine sowing rate (litres of mix per km and per ha) and thus total volume of mix required to sow the site.

Seed Treatments

All legumes (eg *Acacia* and *Kennedia*) are hard-seeded and the seed must be scarified before sowing. The author (Geoff Woodall) routinely uses two 10 second immersions into boiling water (with an immersion in room temperature water between hot water immersion) with consistently good results.

It is very important that each kilogram of seed is placed in an excess (usually five times the volume) of boiling water, that heat is removed via a rinse in cool tap water and that the seed is then dried to its pre-scarification moisture content or bulked up and sown immediately. Mechanical scarification is also suitable though under and over scarification can be a problem.



Seeding with a precision seeder designed by Geoff Woodall (CommVeg seeder). Good weed control, precision sowing, and a stable soil environment are key to successful direct seeding.

For many Australian species treating the seed with smoke stimulates germination (breaks dormancy) and can improve seedling vigor. Smoke also has some desirable fungicidal properties. Many Australian species do not require any seed treatment (e.g. *Hakea laurina*, *Hakea nitida*), however to ensure they do not block the seed box it is recommended that the wings of seeds be removed (rubbed off) prior to sowing.

Timing

Optimum time of seeding differs according to climate - earlier in the more arid climates (e.g. mid-upper catchments) and later in wetter areas (e.g. lower Pallinup). Within a region, optimum time of sowing can vary with soil type (dry soils sown earlier, moist sites sown later). Time of sowing is also species dependent. Typically dry sites are sown late April-May and wet sites, late winter (late July).

Sowing Depth

Aim to sow most fine seeded species at a depth of 2-5mm; in soil prone to drying out (e.g. sand) or when dry seasonal conditions prevail increase the sowing depth by another 2-5mm or so. Sow larger seeds deeper at 10-20mm; in soil prone to drying out or when dry seasonal conditions prevail, increase the sowing depth by another 10mm or so.

Some large seeds (e.g. *Banksia*) do not germinate well at depth, and thus when legumes, larger seeded eucalypts and banksias are combined in a mix a sowing depth of 10-15mm is recommended. When sowing a simple legume mix (e.g. *Kennedia* species and *Acacia saligna* for forage) on light textured soils, sow seeds at a depth of 20-30mm.



An ideal scalp created by the CommVeg seeder. 5-7cm of soil being removed from the centre of each scalp, grading to 0cm on the outer sides of each scalp line.



Soil preparation achieved with the CommVeg seeder. The machine was travelling from left to right and the image shows the view behind the scalper, showing clean dirt being ripped (spring tyne), small tillage disks and the first wheel of the floating seeder arm which places the seed and presses the seed sowing trench.



Farms are often free of dieback because they don't have public access and can be a stronghold for spectacular species such as this bull banksia *Banksia grandis* provided care is taken not to introduce the dieback pathogen.

Approximately forty percent of native plants of south Western Australia are susceptible to dieback (*Phytophthora cinnamomi*). Dieback infestation is chronic on the South Coast (from Walpole to Esperance) where very few large patches of un-infested bush remain. It is therefore critical to the health of the bushland and associated fauna to keep dieback-free status where this still exists.

Landowners with dieback-free bush on private property have the greatest ability to protect these areas by controlling access and following hygiene protocols to prevent infection⁶.

Dieback is easily introduced with contaminated soil and spreads in the soil by water. Hence lower-landscape areas are most susceptible. Infection is most common in areas with rainfall >400mm but wet areas of the landscape in more arid areas are still capable of hosting the dieback fungus.

Strategies to minimise spread of dieback when undertaking revegetation:

- » Avoid revegetation in bushland that is able to regenerate naturally (e.g. isn't inundated with annual grasses) - eliminates the risk of introducing dieback through contaminated seedlings.
- » Consider direct seeding rather than planting seedlings where practical.
- » Purchase plants from nurseries with Nursery Industry Accreditation Scheme Australia (NIASA) accreditation.
- » Complete planting when soil is moist, but not wet.
- » If moving from one area of the bushland to another, ensure that all equipment and shoes are free of mud and soil. Brush soil from footwear and equipment and spray with solution (70% methylated spirits to 30% water) to disinfect between sites. Work from high points to low points in each paddock.
- » Do not use mulch, or only use mulch that has been well composted (the heating process kills *Phytophthora cinnamomi*)⁷.

More information about dieback can be found online at dieback.org.au



» Upper to lower slopes » York gum, salmon gum & red morrell woodlands

Salmon & york gum

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocauarina huegelliana</i>	rock sheoak	
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>	white mallee, woodland mallee	sand, brown sandy loam, ironstone, granite
<i>Eucalyptus flocktoniae</i> / ssp. <i>flocktoniae</i>	merrit tree / mallee	
<i>Eucalyptus longicornis</i>	red morrell	
<i>Eucalyptus loxophleba</i> ssp. <i>loxophleba</i>	york gum	
<i>Eucalyptus salmonophloia</i>	salmon gum	
<i>Hakea preissii</i>	needle tree	
MID STOREY		
<i>Acacia saligna</i>	orange wattle	
<i>Choretrum glomeratum</i>	common sour bush	
<i>Daviesia gracilis</i>		
<i>Hakea ruscifolia</i>	candle hakea	
<i>Rhagodia preissii</i> ssp. <i>preissii</i>		
<i>Senna artemisioides</i>		
LOWER STOREY		
<i>Acacia bidentata</i>		
<i>Acacia consobrina</i>		
<i>Acacia glaucoptera</i> (prostrate form)	clay wattle	
<i>Acacia lasiocarpa</i> ssp. <i>sedifolia</i>		
<i>Acacia sclerophylla</i>		
<i>Acacia tetanophylla</i>		
<i>Atriplex semibaccata</i>	creeping saltbush	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Brachysema celsianum</i>	Swan River pea	along watercourses, flats, wet depressions
<i>Carpobrotus modestus</i>	inland pigface	
<i>Dianella brevicaulis</i>		
<i>Disphyma crassifolium</i>	round-leaved pigface	
<i>Eutaxia microphylla</i>		
<i>Grevillea pectinata</i>	comb-leaved grevillea	sandy or clayey soils over laterite
<i>Kennedia coccinea</i> ssp. <i>coccinea</i>		
<i>Maireana brevifolia</i>	small-leaf bluebush	
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Patersonia occidentalis</i>	purple flag	
<i>Rytidosperma caespitosum</i>	wallaby grass	
<i>Sclerolaena diacantha</i>	grey copper burr	
<i>Templetonia sulcata</i>	centipede bush	

Note - Dominant species shown in bold

MODERATELY DRAINED SANDY DUPLEX

» Crests, upper and lower slopes

» Wandoo and york gum woodlands, mallee

Mallee on sandy duplex



York gum

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam wattle	
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Eucalyptus celastroides</i> ssp. <i>virella</i>		
<i>Eucalyptus flocktoniae</i> ssp. <i>flocktoniae</i>	merrit mallee	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus loxophleba</i> ssp. <i>loxophleba</i>	york gum	
<i>Eucalyptus phaenophylla</i>		
<i>Eucalyptus phenax</i>		
<i>Eucalyptus platypus</i> ssp. <i>platypus</i>	moort	
<i>Eucalyptus latens</i>	narrow-leaved red mallee	
<i>Eucalyptus sporadica</i>	Kangaroo Island mallee	
<i>Eucalyptus thamnoides</i> ssp. <i>megista</i>	brown mallee	
<i>Eucalyptus uncinata</i>	hook-leaf mallee	
<i>Eucalyptus vegrandis</i> ssp. <i>recondita</i>		
<i>Eucalyptus wandoo</i> ssp. <i>wandoo</i>	wandoo/white gum	
<i>Exocarpos sparteus</i>	native cherry	
<i>Hakea laurina</i>	pincushion hakea	
<i>Hakea preissii</i>	needle hakea	
<i>Santalum acuminatum</i>	quandong	
MID STOREY		
<i>Acacia brachyclada</i>		
<i>Acacia harveyi</i>		
<i>Acacia saligna</i>	orange wattle	
<i>Acacia sphacelata</i> ssp. <i>recurva</i>		
<i>Banksia media</i>	southern plains banksia	
<i>Banksia caleyi</i>	Cayley's banksia	
<i>Banksia sessilis</i>	parrot bush	
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	sticky hopbush	
<i>Dodonea pinifolia</i>		

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hypocalymma angustifolium</i>	honey myrtle	sandier soils
<i>Leptospermum erubescens</i>	tea tree	sandier soils
<i>Melaleuca adnata</i>		on heavier soils
<i>Melaleuca hamata</i>	broom bush	on heavier soils
<i>Melaleuca pentagona</i>		on sandy/gravelly soils
<i>Melaleuca spathulata</i>		
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Rhagodia preissii</i> ssp. <i>preissii</i>		
LOWER STOREY		
<i>Acacia chrysocephala</i>		
<i>Acacia consobrina</i>		
<i>Acacia declinata</i>	Pallinup gold	
<i>Acacia lasiocarpa</i> ssp. <i>sedifolia</i>		
<i>Acacia leptospermoides</i> ssp. <i>leptospermoides</i>		
<i>Acacia pulchella</i>	prickly mooses	lower slopes
<i>Acacia sulcata</i> ssp. <i>platyphylla</i>		
<i>Astartea ambigua</i>	check at herbarium	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Brachysema celsianum</i>	Swan River pea	along watercourses, flats, wet depressions
<i>Carpobrotus modestus</i>	inland pigface	
<i>Dianella brevicaulis</i>		
<i>Grevillea oligantha</i>		
<i>Grevillea pectinata</i>	comb-leaved grevillea	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea lissocarpha</i>	honey bush	
<i>Hakea marginata</i>		
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Patersonia occidentalis</i>	purple flag	

POORLY DRAINED SANDY DUPLEX

- » Lower slopes, drainage lines and broad valley floors
- » Sand or sandy loam over clay at 10-60 cm; very wet in winter months
- » Flooded gum, york gum and flat-topped yate woodlands

Acacia declinata



Salt-water paperbark



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam wattle	
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Casuarina obesa</i>	swamp sheoak	in wetter areas
<i>Eucalyptus decipiens ssp. chalara</i>	moit	on sandier soils
<i>Eucalyptus loxophleba</i>	york gum	
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus phenax ssp. phenax</i>	white mallee, woodland mallee	
<i>Eucalyptus rudis</i>	flooded gum	
<i>Eucalyptus vegrandis/ ssp. recondita</i>	clay mallee	
<i>Eucalyptus spathulata</i>	swamp mallet	
<i>Melaleuca raphiophylla</i>	swamp paperbark	
<i>Hakea laurina</i>	pin cushion hakea	
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca strobophylla</i>		
MID STOREY		
<i>Acacia brachyclada</i>		
<i>Acacia cupularis</i>		
<i>Acacia cyclops</i>		
<i>Acacia sphacelata ssp. recurva</i>		
<i>Alyogyne huegelii</i>	lilac hibiscus	
<i>Banksia media</i>	southern plains banksia	
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Callitris pyramidalis</i>	swamp cypress	
<i>Exocarpos sparteus</i>	native cherry	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Jacksonia sternbergiana</i>	stink wood	
<i>Labichea lanceolata</i>	tall labichea	
<i>Maireana brevifolia</i>	small-leaf bluebush	
<i>Melaleuca acuminata</i>		
<i>Melaleuca adnata</i>		

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Melaleuca bracteosa</i>		
<i>Melaleuca hamata</i>	broom bush	
<i>Melaleuca hamulosa</i>		
<i>Melaleuca spathulata</i>		
<i>Melaleuca viminea</i>		
<i>Meleleuca depauperata</i>		
<i>Regelia inops</i>		sandier soils
<i>Rhagodia preissii ssp. preissii</i>		
<i>Templetonia retusa</i>	cockies tongues	
LOWER STOREY		
<i>Acacia consobrina</i>		
<i>Acacia declinata</i>		
<i>Acacia glaucoptera</i>	clay wattle	
<i>Acacia pulchella var. goadbyi</i>		
<i>Acacia redolens (prostrate form)</i>	vanilla wattle	
<i>Astartea fascicularis</i>		
<i>Atriplex semibaccata</i>	creeping salt bush	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Austrostipa juncifolia</i>		
<i>Brachysema celsianum</i>		
<i>Carpobrotus modestus</i>	inland pigface	
<i>Dianella brevicaulis</i>		
<i>Disphyma crassifolia</i>	round-leaved pigface	
<i>Enchylaena tomentosa ssp. tomentosa</i>	ruby saltbush	
<i>Ficinia nodosa</i>	knotted club rush	on sandier wetter sites
<i>Hakea marginata</i>		
<i>Juncus kraussii</i>	sea rush	wet conditions
<i>Juncus pallidus</i>	pale rush	
<i>Kennedia coccinea ssp. coccinea</i>		
<i>Patersonia occidentalis</i>	purple flag	
<i>Sporobolus virginicus</i>	marine couch	

IRONSTONE GRAVEL

- » > 60% overlying clay or hard ironstone
- » Hillcrests and slopes
- » Mallee / wandoo woodland

Mallee heath



Wandoo

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocasuarina huegelliana</i>	rock sheoak	
<i>Banksia grandis</i>	bull banksia	
<i>Eucalyptus astringens</i> ssp. <i>astringens</i>	brown mallet	
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus dorrieni</i>	silver mallee	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus phenax</i>	Kangaroo Island mallee	
<i>Eucalyptus pluricaulis</i> ssp. <i>pluricaulis</i>		
<i>Eucalyptus pluricaulis</i> ssp. <i>porphyrea</i>	purple-leaved mallee	
<i>Eucalyptus sporadica</i>		
<i>Eucalyptus wandoo</i> ssp. <i>wandoo</i>	wandoo	
<i>Eucalyptus xanthonema</i> ssp. <i>xanthonema</i>		
MID STOREY		
<i>Anigozanthos humilis</i>	cat's paw	
<i>Banksia caleyi</i>	Cayley's banksia	
<i>Banksia sessilis</i> /var <i>sessilis</i>	parrot bush	
<i>Banksia sphaerocarpa</i>	round-fruit banksia	
<i>Billardiera fusiformis</i>	bluebells	
<i>Caloathamnus quadrifidus</i>	one-sided bottlebrush	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea ruscifolia</i>	candle hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>	wavy-leaved hakea	
<i>Hakea varia</i>		
<i>Jacksonia furcellata</i>		
<i>Jacksonia sternbergiana</i>	stinkwood	
<i>Melaleuca pentagona</i>		
<i>Melaleuca pungens</i>		
<i>Melaleuca spathulata</i>		low ridges
<i>Allocasuarina thuyoides</i>	horned sheoak	

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
LOWER STOREY		
<i>Acacia browniana</i> ssp. <i>intermedia</i>		
<i>Acacia chrysocephala</i>		
<i>Acacia lasiocarpa</i> var <i>sedifolia</i>		
<i>Acacia pulchella</i> ssp. <i>pulchella</i>	prickly moses	
<i>Acacia stenoptera</i>	narrow winged wattle	
<i>Astroloma compactum</i>		
<i>Astroloma pallidum</i>	kick bush	
<i>Babingtonia camphorosmae</i>	camphor myrtle	
<i>Billardiera variifolia</i>		
<i>Bossiaea eriocarpa</i>	common brown pea	
<i>Caloathamnus sanguineus</i>	silky-leaved blood flower	
<i>Daviesia preissii</i>		
<i>Hakea lehmanniana</i>	blue hakea	
<i>Hakea lissocarpha</i>	honey bush	
<i>Hypocalymma angustifolium</i>	honey myrtle	sandy gravel
<i>Kennedia coccinea</i>	coral vine	
<i>Kennedia prostrata</i>	running postman	
<i>Kunzea preissiana</i>		
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Melaleuca violacea</i>		low ridges
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Patersonia occidentalis</i>	purple flag	
<i>Rytidosperma caespitosum</i> / <i>setaceum</i> / <i>acerosum</i>	wallaby grass	
<i>Stylidium repens</i>		
<i>Tetraria octandra</i>		
<i>Trachymene pilosa</i>		

MALLET HILLS

- » Breakaways or upper slopes and ridges on pink or reddish water repellent soils.
- » May be gravelly, often acidic
- » Blue and brown mallet

Breakaway



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Alocasuarina huegeliana</i>	rock sheoak	
<i>Eucalyptus astringens ssp. astringens</i>	brown mallet	north-western areas
<i>Eucalyptus astringens ssp. redacta</i>	coastal brown mallet	east to south eastern areas
<i>Eucalyptus gardneri</i>	blue mallet	
<i>Eucalyptus pluricaulis ssp. porphyrea</i>	purple leaved mallee	
<i>Eucalyptus thamnoides</i>	brown mallee	
MID STOREY		
<i>Acacia saligna</i>	orange wattle	
<i>Alyogyne huegelii</i>	native hibiscus	
<i>Daviesia gracilis</i>		
<i>Goodia medicaginea</i> *	clover-leaf poison	
<i>Rhagodia preissii ssp. preissii</i>		
LOWER STOREY		
<i>Acacia glaucoptera (prostrate form)</i>	clay wattle	
<i>Atriplex semibaccata</i>		
<i>Austrostipa variabilis</i>	native speargrass	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Banksia armata</i>	prickly dryandra	
<i>Carpobrotus modestus</i>	inland pigface	
<i>Eutaxia microphylla var. microphylla</i>		
<i>Kennedia coccinea ssp. coccinea</i>		
<i>Neurachne alopecuoides</i>	fox tail mulga	
<i>Rytidosperma caespitosum</i>	wallaby grass	
<i>Templetonia sulcata</i>	centipede push	

* maybe toxic to stock

Note - Dominant species shown in bold

SALT-AFFECTED LAND

- » Valley floors, drainage lines and saline seeps on hillslopes
- » Salt-tolerant vegetation: samphire and barley grass
- » Salt-affected land

Melaleuca thyooides & M. cuticularis



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Casuarina obesa</i>	swamp sheoak	sand, clay
<i>Eucalyptus occidentalis</i>	flat-topped yate	on barley grass
<i>Eucalyptus othostemon</i>		
<i>Eucalyptus spathulata</i>	swamp mallet	
<i>Melaleuca cuticularis</i>	salt-water paperbark	high salt tolerance
<i>Melaleuca strobophylla</i>		clay, sandy silt
MID STOREY		
<i>Acacia patagiata</i>		white-grey sand, sandy loam, clay
<i>Callistemon phoeniceus</i>	fiery bottlebrush	range of soil types
<i>Callitris pyramidalis</i>	swamp cypress	shallow duplex
<i>Melaleuca hamulosa</i>		
<i>Melaleuca lateriflora</i>		
<i>Melaleuca ordinifolia</i>		
<i>Melaleuca thyooides</i>		
<i>Melaleuca viminea</i>		
<i>Melaleuca brophyi</i>		clay
LOWER STOREY		
<i>Acacia redolens</i>	vanilla wattle	saline or alkaline clay, loam, sand
<i>Atriplex semibaccata</i>	creeping saltbush	clay, sand, loam, laterite
<i>Austrostipa juncifolia</i>	rush-leaved grass	
<i>Disphyma crassifolium</i>	round-leaved pigface	sand, loam, clay
<i>Enchylaena tomentosa ssp. tomentosa</i>	ruby saltbush	
<i>Ficinia nodosa</i>	knotted club rush	sand, sandy clay, granite, limestone
<i>Juncus kraussii</i>	sea rush	white or grey sand, clay
<i>Juncus pallidus</i>	pale rush	
<i>Maireana brevifolia</i>	small-leaf bluebush	loam, sandy clay
<i>Sporobolus virginicus</i>	marine couch	seedling only
<i>Verticordia plumosa</i>		on barley grass

Note - Dominant species shown in bold

UNDULATING SANDPLAINS

» Pale grey or white sand deeper than 80 cm

» Mallee over heath

Banksia attenuata, leptospermum erubescens



Banksia attenuata & Calothamnus gracilis

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Banksia attenuata</i>	slender banksia	
<i>Eucalyptus angulosa</i>	ridge-fruited mallee	
<i>Eucalyptus decipiens ssp. chalara</i>	moit	
<i>Eucalyptus incrassata</i>	lerp mallee	
<i>Eucalyptus pachyloma</i>	Kalgan plains mallee	
<i>Eucalyptus phaenophylla</i>		
<i>Eucalyptus platypus / ssp. platypus</i>	moort	
<i>Eucalyptus pleurocarpa</i>	tallerack	
<i>Eucalyptus sporadica</i>		
<i>Eucalyptus vegrandis</i>		
<i>Eucalyptus uncinata</i>	hook-leaf mallee	
<i>Acacia microbotrya</i>	manna wattle	
<i>Hakea laurina</i>	pincussion hakea	
<i>Lambertia inermis ssp. inermis</i>	chittick	
<i>Nuytsia floribunda</i>	WA Christmas tree	plant seed near host second year after planting
<i>Santalum acuminatum</i>	quangdong	
MID STOREY		
<i>Acacia brachyclada</i>		
<i>Acacia cupularis</i>		
<i>Acacia cyclops</i>	coastal wattle	
<i>Acacia saligna</i>	orange wattle	
<i>Acacia sphacelata ssp. recurva</i>		
<i>Acacia subcaerulea</i>		
<i>Allocasuarina humilis</i>		
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Banksia caleyi</i>		
<i>Banksia media</i>	southern plains banksia	
<i>Banksia sessilis</i>	parrot bush	
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus gracilis</i>		
<i>Eremea pauciflora</i>		

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Hakea nitida</i>	frog hakea	
<i>Hakea ruscifolia</i>	harsh hakea	
<i>Hypocalymna angustifolium</i>	honey myrtle	
<i>Jacksonia furcellata</i>		
<i>Leptospermum erubescens</i>	teatree	
<i>Leptospermum oligandrum</i>		
<i>Regelia inops</i>		
<i>Melaleuca hamata</i>	broom bush	
LOWER STOREY		
<i>Acacia cochlearis</i>	rigid wattle	
<i>Acacia pulchella ssp. goadbyi</i>		
<i>Banksia pteridifolia</i>	tangled honeypot	
<i>Banksia repens</i>		
<i>Carpobrotus modestus</i>	inland pigface	
<i>Choretrum glomeratum</i>	common sour bush	
<i>Daviesia preissii</i>		
<i>Dianella brevicaulis</i>		
<i>Kunzea preissiana</i>		
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Chloris truncata</i>	windmill grass	

Vegetation communities in the Pallinup Catchment
YELLOW & BROWN DEEP SANDS

- » Valley floors, often as low dunes and on slopes
- » *Banksia*, Christmas tree, paperbarks, sheoak

Banksia attenuata, rock sheoak & jam wattle



Banksia attenuata with flat-topped yate



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Banksia attenuata</i>	slender banksia	
<i>Corymbia calophylla</i>	marri	north west of the Stirling Ranges only
<i>Eucalyptus dorrienii</i>	silver mallee	
<i>Eucalyptus latens</i>	narrow-leaved red mallee	
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus phaenophylla</i>		
<i>Eucalyptus phenax ssp. phenax</i>		
<i>Eucalyptus rudis</i>	flooded gum	on perched water table/ valley floors
<i>Eucalyptus vegrandis</i>		
<i>Eucalyptus uncinata</i>	hook-leaf mallee	
<i>Hakea laurina</i>	pincushion hakea	
<i>Melaleuca cuticularis</i>	salt-water paperbark	wet areas
<i>Nuytsia floribunda</i>	WA Christmas tree	plant seed near host 2nd year after planting
<i>Santalum acuminatum</i>	quangdong	
MID STOREY		
<i>Acacia brachyclada</i>		
<i>Acacia cyclops</i>		
<i>Acacia harveyi</i>		
<i>Acacia saligna</i>		
<i>Acacia sphacelata ssp. recurva</i>		
<i>Acacia triptycha</i>		
<i>Allocasuarina humilis</i>	dwarf sheoak	
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Banksia media</i>		
<i>Callistemon phoeniceus</i>		valley floors
<i>Choretrum glomeratum</i>	common sour bush	
<i>Exocarpos sparteus</i>	broom ballart	

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea ruscifolia</i>	candle hakea	
<i>Jacksonia furcellata</i>		
<i>Leptospermum erubescens</i>	kerosene bush/roadside teatree	
<i>Melaleuca brevifolia</i>		valley floors
<i>Melaleuca cucullata</i>		low landscape
<i>Melaleuca viminea</i>		valley floors
<i>Viminaria juncea</i>	swish bush	valley floors
LOWER STOREY		
<i>Acacia loricata</i> var. <i>loricata</i>		
<i>Astartea fascicularis</i>		
<i>Banksia repens</i>	creeping banksia	
<i>Calytrix leschenaultii</i>		
<i>Carpobrotus modestus</i>	inland pigface	
<i>Ficinia nodosa</i>	knotted club rush	valley floors
<i>Hakea lissocarpha</i>	honey bush	
<i>Kennedia prostrata</i>	running postman	
<i>Melaleuca carrii</i>		
<i>Patersonia occidentalis</i>	purple flag	
<i>Thomasia angustifolia</i>	narrow-leaved thomasia	

ROCKY OUTCROPS

» Granite, dolerite, quartz & hard ironstone » Wandoo, york gum, mallee



Silver mallee

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Acacia lasiocalyx</i>	silver wattle	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Eucalyptus falcata</i>	silver mallee	
<i>Eucalyptus incrassata</i>	lerp mallee	
<i>Eucalyptus loxophleba ssp. loxophleba</i>	york gum	
<i>Eucalyptus phenax</i>	Kangaroo Island mallee	
<i>Eucalyptus platypus</i>	moort	
<i>Eucalyptus sporadica</i>		
<i>Eucalyptus thamnoides ssp. megista</i>	brown mallee	
<i>Eucalyptus vegrandis ssp. recondita</i>	clay mallee	
<i>Eucalyptus wandoo ssp. wandoo</i>	wandoo	
<i>Eucalyptus phaenophylla</i>		
MID STOREY		
<i>Acacia saligna</i>	orange wattle	
<i>Goodia medicaginea*</i>	clover-leaf poison	
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Choretrum glomeratum</i>	common sour bush	
<i>Exocarpos sparteus</i>	broom ballart	
<i>Hakea prostrata</i>	harsh hakea	
<i>Melaleuca elliptica</i>	granite honey myrtle	
<i>Melaleuca hamata</i>	broom bush	
<i>Rhagodia preissii ssp. preissii</i>		
LOWER STOREY		
<i>Acacia browniana / ssp. intermedia</i>		
<i>Acacia lasiocarpa var. sedifolia</i>		
<i>Austrostipa variabilis</i>	native speargrass	
<i>Brachysema celsianum</i>	Swan River pea	
<i>Hakea marginata</i>		winter-wet areas
<i>Kennedia coccinea ssp. coccinea</i>		
<i>Neurachne alopecuroidea</i>	fox tail mulga	
<i>Patersonia occidentalis</i>	purple flag	
<i>Rytidosperma caespitosum</i>	wallaby grass	
<i>Thryptomene sp.</i>		

* maybe toxic to stock

Note - Dominant species shown in bold

WET SOIL

» Swamps, lakes, non-saline hillside seeps » Flooded gum, flat-topped yate
» Various soils waterlogged < 30-80cm for majority of the year



Flat-topped yate, pale rush understorey

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Banksia littoralis</i>	swamp banksia	
<i>Casuarina obesa</i>	swamp sheoak	
<i>Eucalyptus decipiens/ssp. chalara</i>	moit	
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus rudis</i>	flooded gum	
<i>Eucalyptus uncinata</i>	hook-leaf mallee	
<i>Eucalyptus vegrandis ssp. recondita</i>	clay mallee	
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca rhapsiophylla</i>	swamp paperbark	
<i>Melaleuca strobophylla</i>		clay, sandy silt
MID STOREY		
<i>Acacia cyclops</i>	coastal wattle	
<i>Acacia saligna</i>	orange wattle	
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Billardiera fusiformis</i>	bluebells	
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea varia</i>		
<i>Kunzea micromera</i>		
<i>Kunzea recurva</i>		
<i>Leptospermum erubescens</i>	roadside teatree	
<i>Melaleuca hamulosa</i>		
<i>Melaleuca spathulata</i>		seasonally wet flats
<i>Melaleuca undulata</i>		sand or clay
<i>Melaleuca viminea</i>		
<i>Pericalymma spongiocaule</i>		
<i>Viminaria juncea</i>	swish bush	
LOWER STOREY		
<i>Acacia pulchella var. goadbyi</i>		
<i>Baumea articulata</i>	jointed rush	indicator of fresh water
<i>Brachysema celsianum</i>	Swan River pea	
<i>Cyathochaeta avenacea</i>		
<i>Ficinia nodosa</i>	knotted club rush	sandier soils
<i>Hakea marginata</i>		
<i>Hakea prostrata</i>	harsh hakea	
<i>Juncus pallidus</i>	pale rush	
<i>Melaleuca violacea</i>		
<i>Patersonia occidentalis</i>	purple flag	

Note - Dominant species shown in bold

Vegetation communities in the Pallinup Catchment

GREY TO GREYISH BROWN CLAYS

- » Mid to lower slopes and valley floors
- » Flat-topped yate, moort
- » Hard-setting grey clay loam and clay including cracking clays and crabhole clays

Moort

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Eucalyptus annulata</i>	open-fruited mallee	
<i>Eucalyptus celastroides</i> ssp. <i>virella</i>		
<i>Eucalyptus densa</i> ssp. <i>densa</i>		Ongerup area
<i>Eucalyptus flocktoniae</i> ssp. <i>flocktoniae</i>	merrit mallee	
<i>Eucalyptus platypus</i> / ssp. <i>platypus</i>	moort	
<i>Eucalyptus sporadica</i>		
<i>Eucalyptus thamnoides</i> ssp. <i>megista</i>	brown mallee	
<i>Eucalyptus vegrandis</i> ssp. <i>recondita</i>	clay mallee	
<i>Hakea laurina</i>	pincussion hakea	
<i>Hakea preissii</i>	needle tree	
MID STOREY		
<i>Acacia brachyclada</i>		
<i>Acacia harveyi</i>		
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea varia</i>	variable-leaved hakea	
<i>Melaleuca acuminata</i>		
<i>Melaleuca brevifolia</i>	mallee myrtle	
<i>Melaleuca cucullata</i>		
<i>Melaleuca hamata</i>	broom bush	
<i>Melaleuca spathulata</i>	purple honey myrtle	
<i>Melaleuca thyoides</i>	salt-lake honey myrtle	close to water
<i>Melaleuca torquata</i>		
LOWER STOREY		
<i>Acacia bidentata</i>		
<i>Acacia cupularis</i>		
<i>Acacia erinacea</i>		
<i>Acacia ferocior</i>		
<i>Acacia glaucoptera</i> (prostrate form)	clay wattle	
<i>Acacia lasiocarpa</i> var. <i>sedifolia</i>		
<i>Acacia redolens</i> (prostrate form)	vanilla wattle	
<i>Astartea ambigua</i>		
<i>Carpobrotus modestus</i>	inland pigface	
<i>Disphyma crassifolium</i>	round-leaved pigface	
<i>Hakea lissocarpha</i>	honey bush	
<i>Juncus pallidus</i>	pale rush	
<i>Templetonia sulcata</i>	centipede bush	
<i>Verticordia plumosa</i>		

Note - Dominant species shown in bold

Vegetation communities in the Pallinup Catchment

SALT LAKES

- » Variable soils and seasonally waterlogged
- » *Melaleuca* thickets

Salt lake in Balijup Wetland Suite

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Casuarina obesa</i>	swamp sheoak	
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>		
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus othostemon</i>		
<i>Eucalyptus spathulata</i>	swamp mallet	
<i>Eucalyptus thamnoides</i>	brown mallee	on gravelly clay
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca strobophylla</i>		
MID STOREY		
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Callitris pyramidalis</i>	swamp cypress	
<i>Enchylaena tomentosa</i> ssp. <i>tomentosa</i>	barrier saltbush	
<i>Melaleuca acuminata</i>		
<i>Melaleuca adnata</i>		
<i>Melaleuca brevifolia</i>		
<i>Melaleuca cucullata</i>		
<i>Melaleuca thyoides</i>	salt-lake honey myrtle	
<i>Rhagodia preissii</i> ssp. <i>preissii</i>		
LOWER STOREY		
<i>Acacia redolens</i>	vanilla wattle	
<i>Atriplex semibaccata</i>	creeping saltbush	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Chloris truncata</i>	windmill grass	
<i>Disphyma crassifolium</i>	round-leaved pigface	
<i>Ficinia nodosa</i>	knotted club rush	
<i>Juncus kraussii</i>	sea rush	
<i>Maireana brevifolia</i>	small leaf bluebush	

Note - Dominant species shown in bold

GLOSSARY

» BIODIVERSITY

Biodiversity is the variety of all life - the different plants, animals and micro-organisms - the genes they contain and the ecosystems of which they form part.

» COMMUNITY

An assemblage of species populations that occur together in the same place at the same time.

» NSPNR

North Stirlings Pallinup Natural Resources

» ECOSYSTEM

Includes all the animals, plants and physical interactions of a defined space.

» RESILIENCE

The ability of a community to return to its original state following displacement.

» RESISTANCE

The ability of a community to avoid displacement.

» STABILITY

Involves two components: resilience and resistance⁸.

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Note: Soil-landscape information contained in vegetation community tables follows Stuart-Street, 2002 (9) and Stuart Street and Maygold (in prep.) (10), Beard 1979 (11) and Land Monitor Project, 2001 (12) cited Sounness & Whitfield, 2007 (13).



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