



# Creekline Revegetation for Landowners

# Outline

- Planning
- Revegetation techniques
- Species selection
- Site preparation
- Monitoring and maintenance
- Case studies / examples



# Planning - Where do we start?

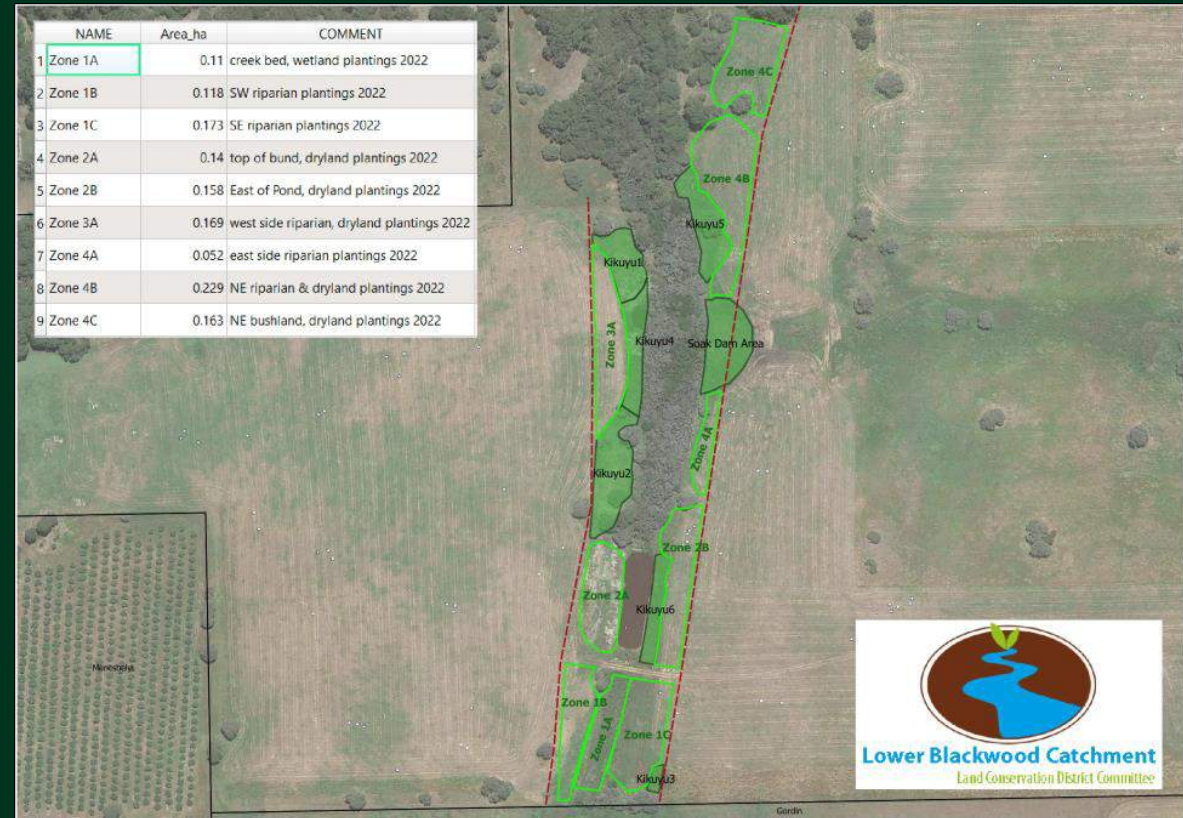
We need a plan:

- Why (purpose)?
- What outcome do we want to see?
- What do we know already?
- What don't we know?
- How do we find what we don't know?



# Planning - What do we need to consider?

- Historic landuse
- Area size and access
- Soils and topography
- Vegetation – condition, species
- Timing
- Budget
- Risks and threats



# Planning - Risk Factors

- Weather – drought, reliance on natural rainfall, erosion (wind, water)
- Site condition – soil type, quality, nutrients, stability, salinity
- Weed competition – nutrients, light, water, allelopathy
- Fauna – kangaroos, rabbits, snails, stock
- Disease – Phytophthora dieback, Marri canker, leaf miners and lerps
- Fire – to and from vegetation



# Planning – Plan Preparation

- Site assessment – conditions and constraints
- Define management zones
- Determine desired outcome for each zone – ultimate vision, layers, species, densities, cover
- Select appropriate techniques for site, budget, and risks
- Create schedule
- Include monitoring and maintenance program



# Species Selection - Basics

Locally occurring native species will perform best – adapted to local environment

Match to:

- Growth form
- Soil - type and depth
- Vegetation community
- Landscape position – permanent inundation, temporary inundation, above high water, upland



# Species Selection - Resources

Where to turn:

- Florabase (WA Herbarium) - <https://florabase.dpaw.wa.gov.au/>
- Internet search
- Reference books
- Local nurseries
- Community landcare and catchment groups
- Local government
- Wildflower society
- Revegetation professionals



# Species Selection - Considerations

- Revegetation technique – direct seeding vs planting
- Commercial availability – seed and tubestock
- Cost – considerable variation in price by species
- Growth rates
- Planting survival rates
- Direct seeding germination success



# Species Selection – Examples from Andrew



# Revegetation Techniques

- Seedling planting
- Direct seeding
- Timing



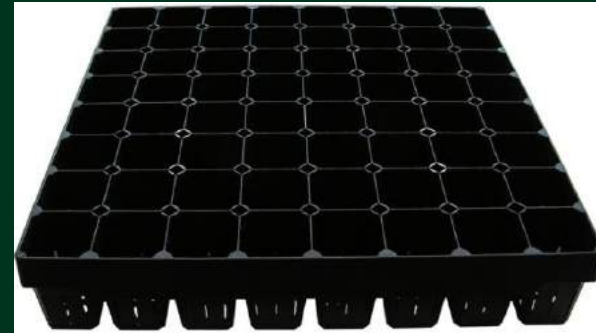
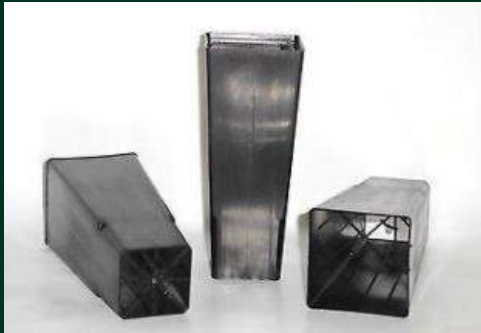
# Revegetation – Seedling Planting Vs Direct Seeding

- Planting
  - More reliable
  - Costlier
  - Plant densities capped by number installed
- Seeding
  - Less reliable
  - Cheaper
  - Huge potential



# Seedling Planting – Sizes

Tubestock – recommend larger sizes (forestry tubes, deep cells)



Advanced sizes – 10 L to 200 L



# Seedling Planting - Densities

- Considerations
  - Project goals, budget, site conditions, etc.
  - Ultimate size when established
  - Anticipated survival rates
- Trees
  - Natural density established vegetation typically 300 - 500 trees / ha
  - Separate crowns when mature by 10 m to reduce fire risk
- Shrubs and groundcovers – 1 / m<sup>2</sup>
- Rushes and Sedges
  - Typically 4 – 6 / m<sup>2</sup>
  - Plant in clusters if limited numbers



# Direct Seeding – Seed Mix Design

- Seeding rate – typically 3 – 6 kg/ha
- Seed counts vary – 16 g / seed to 20,000 seeds / g
- Prices vary significantly - \$100 - \$100,000/kg
- Sourcing
  - On site collections – timing, species, quantities
  - Commercial supply
  - Provenance considerations



# Revegetation Timing

- Planting
  - Typically May to September
  - Soil moisture critical - recommend 100 mm of autumn rainfall before starting
  - Inundated areas wait until peak and plant in stages as waters recede
- Seeding
  - Autumn to no later than end June
  - If site weedy wait until after germination, treat, then prepare site and seed
  - Can seed earlier in weed free areas, however seeds exposed to elements and predation
  - Pre-treat seed to break dormancy mechanisms



# Site Preparation - Basics

- Weed management
- Earthworks - preparation of planting / seeding beds
- Erosion control
- Nutrients and soil health
- Site protection
- Disease prevention and management
- Pest Management



# Weed Management

- How? – chemical, physical, biological, combination
- Considerations
  - Invasiveness
  - Distribution
  - Growth form and reproduction method



# Weed Management - Chemical

## Herbicides

- General knockdown – kill everything
- Selective – only affect certain types of plant (e.g. grass, broadleaf)
- Water / environment sensitive

## Application Methods

- Spot / blanket spray – backpack, hose reel
- Boom spray – tractor or ATV
- Basal bark – herbicide + bark penetrant
- Drill and fill – drill hole into trunk and inject herbicide
- Cut and paint – apply herbicide immediately



# Weed Management - Physical

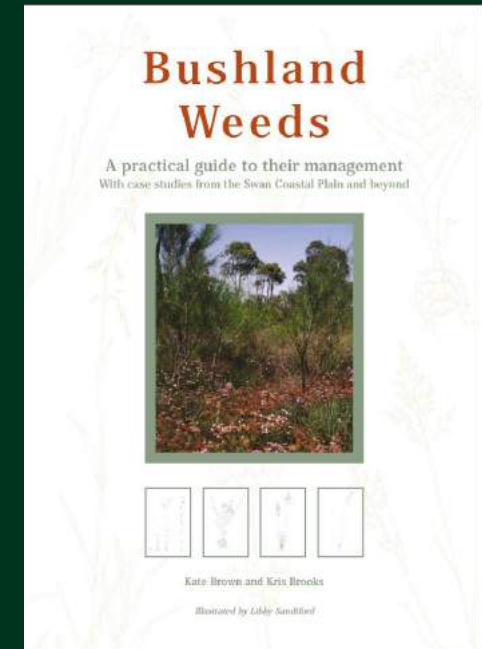
- Slashing – remove biomass, expose / encourage new growth
- Brush cutting – in hard to access locations
- Hand pulling – young saplings, isolated plants, sensitive areas
- Dead heading – removing seed prevents additions to seed bank
- Felling – woody weeds, paint with herbicide if re-sprouter
- Fire – removes biomass, encourages germination



# Weed Management – Resources

- Florabase - <https://florabase.dpaw.wa.gov.au/>
- Bushland Weeds: A Practical Guide to Their Management – Brown et. al.
- Department of Primary Industries and Regional Development

<https://www.agric.wa.gov.au/pests-weeds-diseases/weeds>



# Weed Management – Grasses

Generally for common species:

- Chemical – fusilade 10 mL / 10 L at 3-5 leaf stage, 1% glyphosate when no natives to avoid
- Timing – during active growth period – annual grasses winter, rhizomatous (i.e. couch, kikuyu) summer
- Physical – fire stimulates high levels of seed bank germination



# Weed Management – Blackberry

- Chemical – 1 g / 10 L metsulfuron-methyl (summer / autumn)
- Physical - Create access channels thick patches – slash, or place boards
- Mulch canes
- Spray regrowth early if any



# Weed Management – Arum Lily

- Herbicide – metsulfuron-methyl or chlorsulfuron 0.4 g / 15 L + pulse (leaf penetrant)
- Timing – when flowering (plants most vulnerable)



# Weed Management – Sydney Golden Wattle

- Herbicide – basal bark  
Triclopyr / diesel mix 18  
mL / L
- Manual – hand pull young  
saplings, fell mature  
plants, younger plants  
may occasionally resprout



# Weed Management – Cottonbush

- Chemical – foliar spray glyphosate 1.5%, cut and paint 50% glyphosate
- Physical – hand pull young saplings, mature can release seed
- Biological – host plant of Lesser Wanderer Butterfly larvae – can reduce / halt seed production if introduced



# Weed Management – Red Ink Plant

- Chemical – glyphosate 1% plus penetrant
- Physical – hand remove small infestations, cut root at least 5 cm below ground



*Phytolacca octandra*

Photos: P. Maloney



# Site Preparation – Earthworks

- Reshaping
- Ripping
- Ripping and mounding
- Scalping
- Rotary hoeing
- Harrowing



# Earthworks – Re-shaping

- Why? – change elevation (raise soil levels, create depressions), reduce slope angles, smooth surfaces for matting, erosion management, etc.



# Earthworks - Ripping

- Why? – reduce compaction, increase moisture infiltration



# Earthworks – Ripping and Mounding

- Why? – raise soil above surrounds, increase soil temperatures



# Earthworks - Scalping

- Why? – remove shallow weed seed bank to reduce competition



# Earthworks – Rotary Hoeing

- Why? – bury vegetative litter and bring soil to surface



# Earthworks - Harrowing

- Why? – prepare for direct seeding



# Site Preparation – Erosion Control

- Universal soil loss equation  $A = R \times K \times LS \times C \times P$ 
  - R = rainfall factor
  - K = erodibility factor of soil type
  - LS = slope length-gradient factor – steeper longer slopes higher factor
  - C = crop / vegetation and management factor
  - P = support practice factor – cross slope cultivation, contour farming, strip cropping
- Plants only provide limited function – less whilst establishing
- Difficult in high flow rate / volume conditions – slow flow if possible (riffles, meanders)



# Erosion Control Options - Upland

- Interception – ripping, contour banks, coir logs, sediment fences
- Mulch



# Erosion Control Options - Streams

- Erosion control matting
- Rock armouring
- Check dams, rip rap, basins
- Stream realignment – meanders



# Erosion Control Options - Bioengineering

- Using natural/biodegradable products to diffuse water energy
- Increase bank stability until vegetation has established



# Site Preparation - Nutrients and Soil Health

- Fertiliser
  - Not recommended in inundation areas
  - Low P for natives
  - Generally low rates
  - Tablets when planting
- Mulch
  - Low organic content
  - Reduce evaporation
- Mycorrhiza and soil bacteria
  - Refresh 'dead' soil
  - Compost vs granular product



# Site Preparation - Site Protection (Fencing)

What are you protecting the site from?

- Rabbits – 1.2 m chickenmesh skirt buried 300 mm
- Kangaroos – 1.2 m can be effective short distance, 1.8 m otherwise
- Stock
- Vehicles

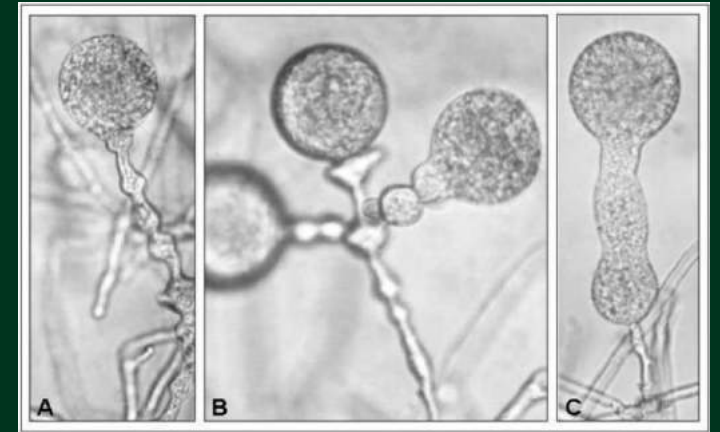
Tree guards an option for smaller planted sites to protect from rabbits and kangaroos



# Site Preparation – Disease Prevention and Management

*Phytophthora* Dieback – the biological bulldozer

- 40% of all species susceptible
  - Ensure all tools, equipment, vehicles free of soil before entering site
  - Ensure clean on exit to prevent spread if already present
  - If site infected select species that are tolerant or less susceptible
- [http://www.cpsm-phytophthora.org/resources\\_supRes.php](http://www.cpsm-phytophthora.org/resources_supRes.php)
- Impossible to remove once present
  - Can lessen impact and slow spread by phosphite treatment, needs repeated application every few years



# Site Preparation – Pest Management

## Rabbits

- Baiting – don't use if other native fauna present (i.e. Bandicoots)
- RHDV – warmer months only, needs flies to spread
- Warren destruction / fumigation

## Kangaroos

- Fencing only proven option

## Native Water Birds

- Native Birds such as Swampheens can remove plants



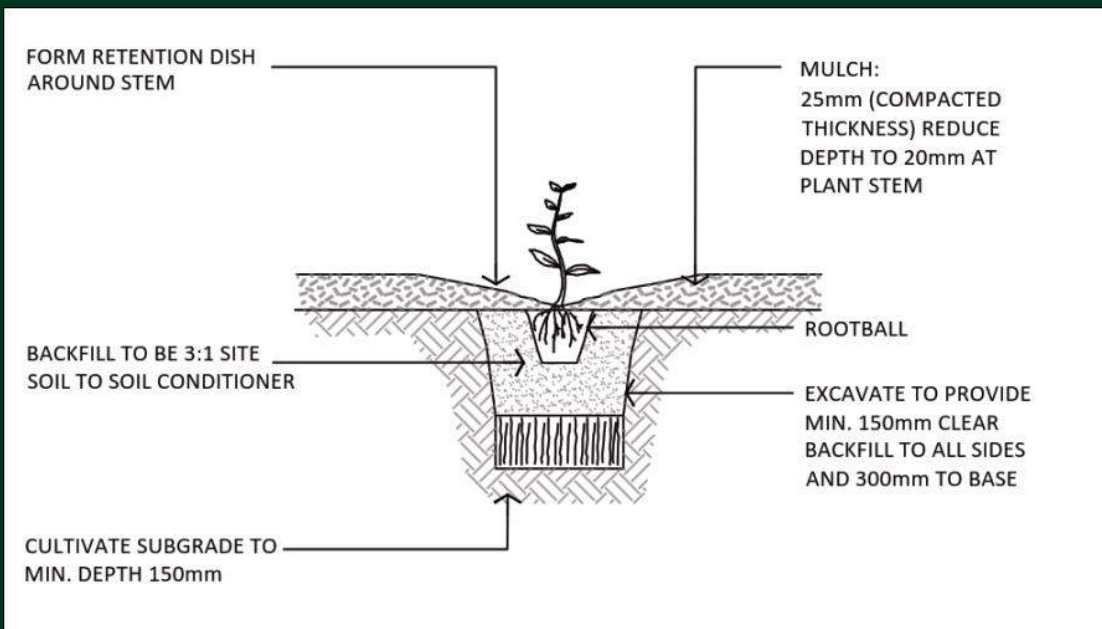
# Direct Seeding

- General rules – bare soil yields best results, won't work in weedy locations, surface cultivation essential, use bulking agent for even distribution, pre-treat to break dormancy mechanisms
- Seeding techniques – hand broadcast, precision seeding (mechanical)



# Seedling Planting - Techniques

- General rules – seedling rootball below soil surface, no mulch touching stem (causes rot), depression for directing water to plant
- Techniques – trowel, Pottiputki, auger



# Seedling Protection – Tree Guards

- Types – plastic bag, corflute, mesh
- Purpose – protection from herbivory, overspray, disturbance, visual



# Post-installation – Monitoring & Maintenance

- Monitoring
  - Track and compare progress against project goals
  - Identify potential problems early
  - Guide maintenance activities
  - Study plant behaviour and environment to make more informed decisions
- Maintenance
  - Weed control
  - Tree guard maintenance and removal
  - Infill planting
  - Fauna / fence maintenance



# Monitoring

- Attributes – plant densities, survival rates, seed germination rates, species richness and diversity, native cover, weed cover and species, resilience, identify early factors potentially affecting outcome
- Duration – two to five years typical, snapshot, successional pathways



# Maintenance – Weed Management

- Species – species present, abundance, distribution
- Timing – species specific, timing generally based on growth form (annual, perennial, geophytes, grasses, woody), before flowering to prevent seed set
- Considerations
  - Now have establishing natives to avoid
  - Tree guards provide protection from spray
  - Regular follow up treatment will reduce populations
  - Continue until no longer competing with establishing natives
  - Succession – dominant weeds may have suppressed others not seen before



# Maintenance – Tree Guards

- Plastic bag guards move in the wind - need frequent adjustment
- Corflute guards may rotate in the wind with only one stake
- Remove guards when no longer required – restrict plant development



# Maintenance – Infill Planting

- Purpose – to achieve target plant density, increase species richness
- Survival rates (first summer) – with appropriate planning and timing survival rates are typically in the range of 60 – 90% over the first summer
- Typical allowances of 30% infill planting in maintenance year 1, 15% year 2
- Survival after the second summer is a general indicator of longer-term success



# Maintenance – Fauna / Fence Maintenance

## Fauna Maintenance

- Most losses due to fauna in first year after planting
- Rabbits pull out newly planted seedlings to target roots
- Plants established from seed less affected
- Kangaroos mainly eat new leaves and shoots and prefer certain species
- Risk of permanent damage reduces over time once established – less palatable and increased resilience
- Leave guards on longer for smaller plants
- Repair fencing as necessary to exclude outside access



# Example Project 1 – Butterly Rd, Yallingup



Image credit: J.Sherborne, Butterly Rd Yallingup



# Example Project 1 – Butterly Rd, Yallingup

- Considerations
  - Erosion Control
  - Kangaroo grazing
  - Species selection
- Design / strategy
  - Fence to exclude kangaroos
  - Removal of declared weed (Arum lilies, Easter lilies)
  - Brushing with branches for stability and seed dispersal
  - Fast growing species provide quicker benefits and can be removed later  
(Cape Wattle, Acacia saligna)



# Example Project 1 – Butterly rd, Yallingup



Image credit: J.Sherborne, Butterly Rd Yallingup BEFORE



Image credit: J.Sherborne, Butterly Rd Yallingup AFTER



# Example Project 1 – Butterly Rd, Yallingup



Image credit: J.Sherborne, Butterly Rd Yallingup BEFORE



Image credit: J.Sherborne, Butterly Rd Yallingup AFTER



# Example Project 2 – Vasse Diversion Drain

- Considerations
  - Erosion control and landform stability
  - Weed control
  - Species selection
- Design / strategy
  - Weed control and prevention - mulching
  - Fencing to protect from fauna and human traffic
  - Landform preparation – weed removal, matting, bioengineering
  - Surface preparation – rotary hoe, ripping etc, mulch spreading etc.



# Example Project 2 – Vasse Diversion Drain



Image credit: A. Johnston, Vasse Diversion Drain Busselton BEFORE



Image credit: A. Johnston, Vasse Diversion Drain Busselton AFTER



# Example Project 3 – Dalyellup Wetland

- Considerations
  - Weed infestation
  - Seasonal fluctuation of water
- Design / strategy
  - Multiple pre-planting weed control events.
  - Selected suitable species to conditions
- WHAT WE MISSED
  - We didn't predict Swamphens removing seedlings



# Example Project 3 – Dalyellup Wetland



BEFORE

Image credit: All images J.Sherborne, Dalyellup Wetland AFTER



# Example Project 4 – Prosser Property, Scott River

- Considerations
- Design / strategy



# Example Project 4 – Prosser property, Scott River



Image credit: A. Hemsley, Prosser Property, Scott River BEFORE



Image credit: A. Hemsley, Prosser Property, Scott River AFTER



Thanks for your time Q & A

