Planning at Peniup

Restoration at the property scale - lessons learned in Gondwana Link

Tree belts being established along contour lines at Peniup.

By Justin Jonson

What would you do if you were given the challenge of planning the restoration of 1000 hectares of agricultural land in a biodiversity hotspot renowned for its heterogeneous ecosystems? This is the challenge being faced at Peniup, a property recently acquired by Greening Australia and Bush Heritage as part of the Gondwana Link project. While restoration is increasingly recognised as essential for biodiversity conservation, it costs a lot in money and time – typically taking many years to deliver the desired outcomes. Good planning, grounded in good theory, and delivered through rigorous establishment techniques, are keys to success. Information gained from project outcomes can then be used to inform future restoration activities.

Ecological restoration is an information-rich arena. Knowledge from several different fields of study need to be drawn together to ensure an effective recovery process is established. The state-transition from an agricultural paddock to a re-establishing native plant community is a highly sensitive pathway. Attention to detail throughout the whole process is required to overcome several thresholds of transition.

The approach used in developing a restoration plan for Peniup involved building on a foundation of local knowledge, geospatial data sets, and the results of previous on-ground efforts. This information was then framed within ecological theory, prompting new approaches in establishment to bridge the gap between theory and practice.

Always begins with an objective

And what does all this mean for Peniup? The decision making process at Peniup began with the defined **objective** of re-establishing a self-replicating biologically-diverse plant system, ecologically informed in its design, and consistent with the heterogeneous mosaic of plant associations found in the dryland transition zone of Western Australia.

But then there was the added constraint that the project's **funding** was provided through a carbon contract. This required a carbon storage focus throughout the planning, design and decision making process. Interestingly, this constraint helped to develop a composition focus

A newly developed five-row direct-seeding machine minimises soil displacement, and reduces row spacing at Peniup.

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for our species mixes, with the upper-most stratum of plants(eucalypt mallees and trees) reserved for carbon-rich species.

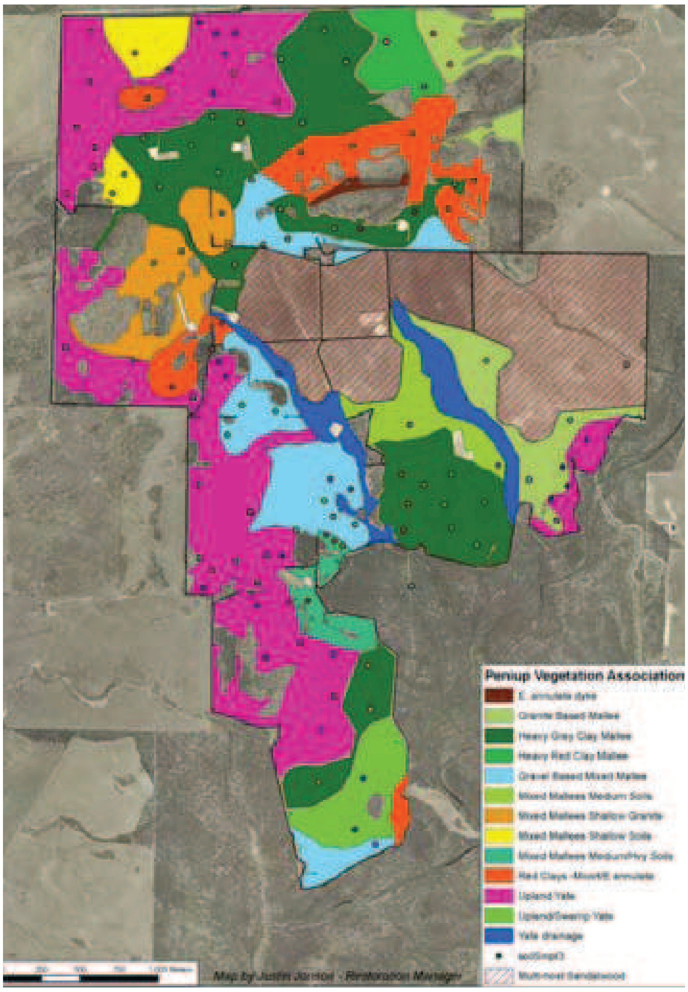
In addition, special consideration was paid to the initial composition of plant assemblages and their forecasted pathway of succession (given different ratios of species planted, and the duration of each individual species' life cycle). As reestablished plant communities were composed of both short and long lived species, **temporal variability** of natural attrition was considered.

Overarching all of this, the Peniup project aimed to improve on 'best practice' **techniques** to inform the design and establishment of revegetation. To this end, analytical assessments were undertaken of the biophysical variables across the property to inform the selection of new establishment techniques. Ongoing referral to the project objectives and goals helped focus the decision making process throughout.

Sowing the good seed

An example of this was the transition from a generalised 'mixed soup' seed mix, composed of species from various soil types and landscape positions, to a set of defined 'vegetation associations', composed of species mixes specific to soil types and landscape positions. This decision was informed by ecological models of community assembly (Temperton & Hobbs, 2004), and marks a shift from the deterministic model (and management approach), to a model of alternative stable states of assembly. Where information was not available, yet easily gathered within short times frames, on-ground works and further analyses were undertaken to inform decision making. The development of a detailed soil survey to map subsurface patch distributions, coupled with plant species specific information on soil type preferences, is a good example of that process.

We have tried to reduce **the risk of failure** by planting at the right time, establishing good weed management, and getting seed placement at the right depth. While we cannot know for sure what the seasonal conditions will be for a given year, using the best available establishment techniques can help reduce chances of failure.



Restoration map of the 'vegetation associations' for North Peniup determined from detailed soil mapping.

The **selection** of areas for restoration was primarily influenced by their contribution to consolidation of existing remnant bushland, and their contribution to the protection of creeks and drainage lines.

A learning process

What have we learned from our experiences at Peniup? Initial results from a 250ha planting in 2008 confirmed that 'lighter' soils demonstrated significant capacity for re-establishment through direct seeding, as opposed to the 'heavier' more challenging soils. This information feeds directly into future project plans, highlighting the need for alternative establishment techniques on challenging soils, and more strategic prioritization of establishment approaches and time lines for a property.

Works in 2008 also included the development of a new direct seeding machine, which incorporated a delivery system able to reduce soil displacement. This enables follow-up seeding treatments to occur at the same location if initial establishment is unsuccessful. Row spacing delivery of the new seeder was also improved, reducing row spacing from 3m to 1.2m.

While a set operational budget determines how much one can spend on establishment, detailed costing records provide valuable information for future decision making. A significant cost in our 2008 works was the biodiverse seed mix used for direct seeding, making up to 30% of our total operational budget.

Follow up monitoring and evaluation has started (27 plots to date) to quantify the number of plants successfully germinated in the field. These findings, combined with detailed information on seeding rates and cost of seed, will help us evaluate the cost-effectiveness of re-establishing biodiverse plant communities in restoration projects. This information feeds directly into management decisions for future projects.

Calothamnus quadrifidus *established from direct seeding.*

While we have improved our project planning and establishment techniques at Peniup, much remains to be learned in this multifaceted field and highly variable environment. We hope the results of this property scale work will help inform the broader UQ-Gondwana Link project (Gondwana Link Research Idenitifying Priorities Project or GRIPP). We are also investigating opportunities for applying restoration prioritisation frameworks and decision support tools for future projects in Gondwana Link.

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Reference

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Prioritising restoration actions in California

Through a productive collaboration with Dr Jutta Burger and Dr Megan Lulow at the Irvine Ranch Conservancy in southern California, AEDA scientists, Dr Kerrie Wilson and Marissa McBride have developed a unified theory for restoration prioritisation.

As discussed in the main story, the Peniup restoration outlines the many challenges faced when planning restoration. There can be multiple objectives, time delays, multiple restoration techniques that cost different amounts and deliver different outcomes, feedbacks between investments, stochastic events, and the possibility that the restoration may not succeed. Despite this complexity, decisions must be made about how to restore, where and when the restoration should occur.

Applying their theory and associated decision support tool to the Irvine Ranch, Wilson and colleagues have identified the combination of restoration sites and activities, and the schedule for their implementation that will provide the greatest and most resilient improvement in habitat coverage for a fixed budget and operational limitations.

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