

Of the threatened species listed above, only four: wallum froglet, wallum sedgefrog, wallum rocketfrog, and grey-headed flying fox. A further five EPBC migratory bird species were identified on site: black-faced monarch, cattle egret, great egret, rainbow bee-eater and rufous fantail (ARUP, Dec 2011).

3.6 Weed Presence

While other common weeds were noted on-Site, the most significant plants noted as having the potential to compete with native regrowth species and therefore block Site succession are listed below:

- *Setaria sphacelata* (setaria). This grass has been utilised over northern and eastern portions of the Site. It can persist in a variety of conditions including seasonally inundated and slightly elevated paddocks with poor drainage and has the ability to form dense thickets that block light as well as build high fuel loads that can threaten managed vegetation. It is one of the few grasses that persists within regrowth vegetation and it is able to disperse within shaded *Melaleuca* remnants;
- *Lantana camara* (lantana). This shrub has been noted over most vegetated areas within the Site and only seems to have been kept in check by regular fire regimes. It has the ability to form dense thickets in both open and semi-shaded areas;
- *Pinus sp.* (pine wildlings). Residual seed and unlogged trees are prevalent throughout the site and can persist in most conditions on-Site with the exception of mudflat communities to the east. The pines can grow to over 20m and can alter VMU site succession through overabundance and subsequent resource reallocation;
- *Acacia disparrima* and *A.leiocalyx*. While native to most communities on-Site, these pioneer species can present a biotic filter to the diversity of VMU site succession through over abundance and subsequent resource reallocation.

Where practical, special attention has been placed within VMU objectives on control of these weeds to remove obstacles to VMU site succession. Other weeds should be noted within the context of the projected ecological rehabilitation plan.

Some areas studied within the Strategy had limited coverage of giant rat's tail grass (*Sporobolus pyramidalis* and *S. natalensis*), a Class 2 declared pest under the LPA. While this weed was not observed blocking successional processes as it prefers open areas and does not tolerate shade, targeted control of this weed will be undertaken prior to and following rehabilitation works. Greening Australia will be engaged to develop and implement a Weed Management Strategy focusing on this weed in non-rehabilitation areas to restrict its spread.

3.7 Site Trajectories

Disturbed ecosystems (as well as undisturbed ecosystems) moves on a path or trajectory into various different states based on their condition and environmental conditions (van Andel, 2006). The Site has a number of short-term vegetation trajectories, although many of these were difficult to gauge due to recent chopper

rolling activities. In the absence of intensive historical analysis these trajectories seem to be predominantly influenced by:

- time since clearing,
- vicinity to remnant vegetation/seed sources,
- introduction of improved pastures (particularly setaria); and
- inundation levels.

In general, sites that have been recently cleared are lacking improved pastures and are situated adjacent to remnant vegetation in low-lying areas appear to recover far more rapidly than heavily managed and isolated areas on higher/eastern parts of the Site.

Figures 5 – 8 give a graphic indication of the Site's ability to rapidly recover if seed is present and biotic blocks to succession (such as setaria) are absent.



Figure 5: *Melaleuca* regrowth within a poorly drained area with minimal improved pastures 100m from remnant vegetation.



Figure 6: *Melaleuca* regrowth within a well drained area with improved pastures 200m from remnant vegetation.



Figure 7: Mature *Melaleuca* regrowth (with *Pinus sp.*) within a well drained area adjacent to remnant vegetation.



Figure 8: Robust *Melaleuca*/scribbly gum community remnant with low weed coverage and diverse, functional shrub and ground layers.

3.8 Key Threats to Obtaining Remnant Status

Following literature review, interview of key site land managers and subsequent field inspections the following key threats have been identified:

- Unplanned fires/inappropriate fire regimes (Greening Australia, 2010);
- Weeds as listed in Section 3.6;
- Inappropriate grazing regimes (cattle seem to aid restoration by keeping improved pastures down but can damage regrowth if over-stocked; and
- Clearing. Chopper-rolling is being undertaken on-Site to both remove pine stumps, stimulate regrowth and return the area to a more appropriate drainage pattern by removal of mounding. Long-term chopper-rolling usage however could affect regrowth quality by seedbank depletion if treated areas are not adjacent to remnants and select species are unable to seed).

Former pasture areas are likely to have higher nutrient levels, including phosphorus and nitrogen. This may make it difficult to restore heath vegetation in such areas, as many heath species find high phosphorus levels in the soil toxic (e.g. *Banksia* and other Proteaceae species). Higher nutrient levels are also likely to lead to greater numbers of exotic understory species in the eucalypt communities present on some of the drier areas of the site. Such high nutrients tend to build up in cattle resting areas due to the concentration of cattle dung in these locations. On areas that have had pine plantations, organic carbon and available phosphorus levels are moderate to high, most likely due to past fertilisation practices (Greening Australia, 2000).

3.8.1 Changes in Topography

Micro-topography of much of the Site appears to have been altered on pine plantation areas and standard plantation management practices would reflect this. Plantation areas are typically covered with parallel furrows and ridges (see Figure 9). The furrows are inundated for long periods and are slow to drain. They are thought to provide poor habitat for terrestrial mammals and reptiles and are likely responsible for the poor representation of these species at the Site (BAAM, 2010).

Expected changes in topography will occur during development of the site and subsequent sections map out fully the process to identify the most sustainable vegetation following bulk earthworks and stormwater management.



Figure 9: Furrows constructed to drain areas planted for pines have a major impact on micro-topography and hydrology

Little is known about how hydrological changes affect the native vegetation dynamics on the Site; therefore, appropriate hydrological regimes for rehabilitation are provided in only the broadest possible terms. With this in consideration more VMU-specific plans will require generation as part of the anticipated Plan. However, there are key hydrologic factors that will drive the development of vegetation on-Site, including:

- Very small differences in water levels or frequency of inundation can lead to dominance by distinctly different plant species (e.g. *Melaleuca*, Wallum or Eucalypt). This suggests it will be difficult to accurately predict the longer-term vegetation types that will develop in intermediate elevation areas of site. This may not be possible until the hydrology reaches a dynamic equilibrium at the Site following logging and establishment of preferred land use options;
- The vegetation itself will also change hydrologic conditions over time, due to changes in evapotranspiration (plant water use) rates with different density and growth rates of the vegetative cover at a site. Logging of pine plantations is likely to cause a rise in the water table, due to reduced evapotranspiration. This condition is likely to persist for an extended period, until regrowth evapotranspiration rates begin to approach those of the pine plantations; and
- Rehabilitation of wet heathland and *Melaleuca* wetland vegetation would involve reinstating a wet and dry cycle, consisting of several months of water logging/shallow flooding, similar to that originally occurring on the Site.

Furrow removal may be necessary to reduce ponding and associated mosquito habitat, although some ponding may aid in diversifying habitat. Furrow removal may be required if human occupation is to increase on Site or surrounding areas (e.g. housing, industry, recreation reserves etc).

Operational considerations for rehabilitation that relate to the presence of such furrows include:

- The extent of furrow removal necessary for successful rehabilitation and the most effective means of furrow removal;
- The effects of furrow retention on the development of native vegetation. In time terrestrial species on the ridge tops may become dominant, shading out or suppressing growth of wet heath species that colonise furrows; and
- Furrows create a hindrance to maintenance activities by impeding vehicle access for planting, direct seeding and follow-up maintenance and making foot inspections of the Site more difficult and dangerous.

3.9 Seed Collection Data

Direct seeding and tubestock propagation will be an important part of establishing framework species coverage as well as enhancing shrub and groundcover layers.

To aid future rehabilitation efforts, relevant seed collection data including potential seeding periods and on-Site collection points are provided in Appendix B. Collections based on this information are currently underway.

4 VMU Objectives and Associated Treatments

VMUs have been utilised throughout the Strategy as they enable the site to be divided into units that have similar characteristics, goals and resultant treatments.

The following sections are based on the information outlined in Section 3. This Section outlines VMU objectives, associated treatments, costings, implementation guidelines and additional measures to consider as part of the Strategy.

Key factors to consider when reviewing these sections include:

- Chopper rolling to remove pine stumps and pine regrowth that has occurred within most regrowth-based VMUs over the last two years. This prevents a clear indication of regrowth potential within such areas. Site rehabilitation methods are developed for VMUs as observed during the field survey and these objectives should be reassessed during the drafting of the detailed restoration plan in accordance with the timeline associated with the development and infrastructure to be constructed over time;
- Reduced grazing over most of the Site which has influenced the distribution of introduced pastures including *Setaria* and may result in potentially inaccurate estimates on regrowth potential;
- The lack of research and broadscale practice of sites of similar scale within the Caloundra area.

4.1 Key VMU Rehabilitation Objectives

The primary target of all VMUs on-Site is the attainment of remnant status under the *Vegetation Management Act 1999* and to increase the biodiversity on-Site.

As noted previously, Regional Ecosystems have been utilised as a basic ecological building block as it is believed that the key species described within each ecosystem type allow for major ecosystem functions and persistence within a landscape.

Table 6 outlines the five primary treatment techniques and their advantages and disadvantages.

Figures 10 - 11 show the extent of VMUs on site.

Several VMUs require additional specifications or a combination of treatments and these as well as standard treatment summaries are reflected in Appendix A.

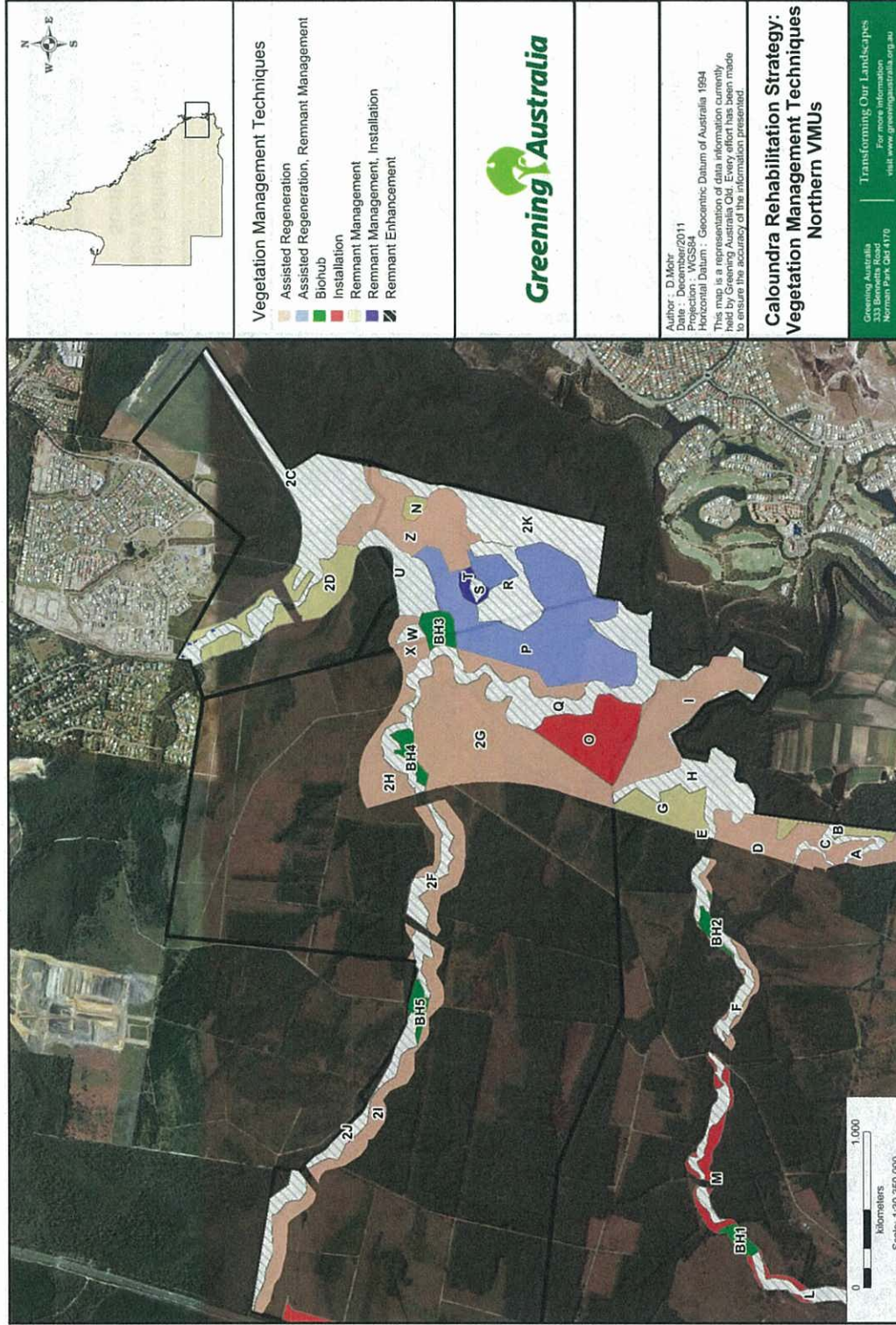


Figure 10 Northern VMUs and Primary Treatments

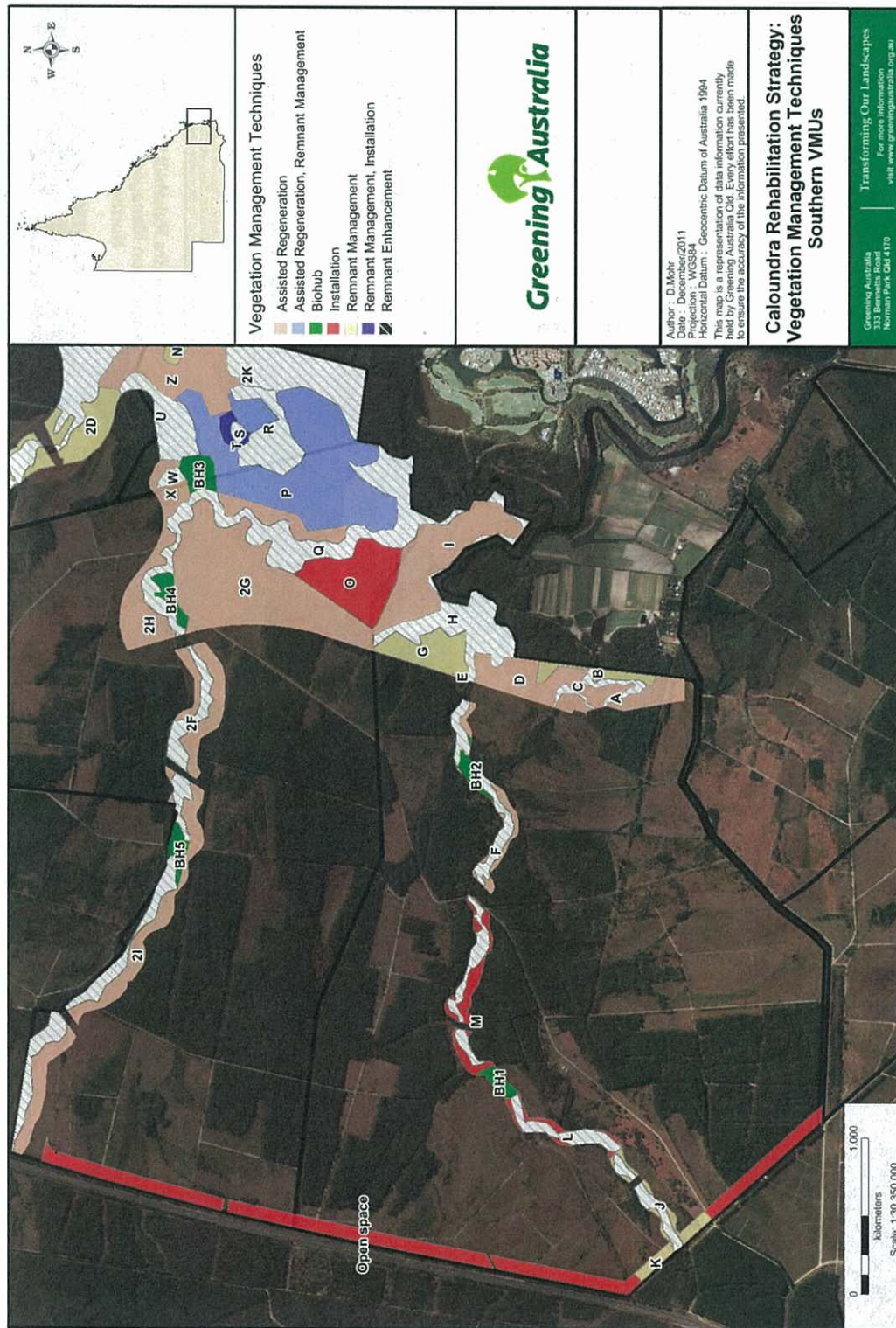


Figure 11 Southern VMUs and Primary Treatments

Table 6 Treatment Types and Summaries

Treatment type	Description/Additional targets	Advantage	Disadvantage	Key proposed treatments					
				Fire	Soil stimulation	Direct seeding	Tubestock installation	Weed control	Crash grazing
Remnant enhancement	Treatment of mature vegetation (mapped as remnant or non-remnant) which is largely limited to focused control of key weeds noted as having the potential to block successional processes.	Little resource allocation. Results are highly controlled and can be noted within a short space of time.	Limited opportunity to enhance existing biodiversity directly or within a short timeframes.					✓	
Regrowth management	Treatment of immature vegetation of varying ages. May require targeted control (e.g. spot spraying or mechanical treatments) of either native or non-native species to ensure remnant status can be obtained but with a secondary goal of biodiversity enhancement.	Lower resource allocation.	Limited control over results with little opportunity to introduce species not represented in seedbank. Generally shorter timeframes than installation-based techniques.					✓	
Assisted regeneration	Treatment of areas with regeneration potential but limited current regrowth. Will typically require triggering of seedbank through measures outlined in Trial section (e.g. fire, reduction of competitive species through grazing or herbicide control). Also may include limited direct seeding/tubestock installation passes through the centre of VMUs to boost groundcover/shrub and framework biodiversity and/or ensure adequate framework coverage.	Moderate resource allocation. Moderate opportunity to introduce additional species. Opportunity for greater community to benefit from trial-based research.	Little implementation of these techniques has been trialled at scale. Most work will be reliant on successful techniques obtained from trials. Longer timeframes with limited control over results.	✓	✓	✓		✓	✓
Installation	Intensive installation of vegetation either through direct seeding or to a lesser degree tubestock installation. Riparian buffer edges are to be planted with dense shrub species and groundcovers to reduce sunlight infiltration and resultant over-	Higher opportunity to introduce additional species. Opportunity for greater community to benefit from trial-based research.	Little implementation of these techniques has been trialled at scale for the majority of ecological communities on-site. Most work will be			✓		✓	

Treatment type	Description/Additional targets	Advantage	Disadvantage	Key proposed treatments					
				Fire	Soil stimulation	Direct seeding	Tubestock installation	Weed control	Crash grazing
	abundance of grassy weeds and lantana.		reliant on successful techniques obtained from trials. Results may be poor in areas absent of native vegetation due to lack of appropriate soil biota.						
Biohub installation	Dual primary targets exist for this type of VMU: Ensure framework species are sufficient to obtain remnant status but also focus on introduction of EVNT species (as listed previously) and an increase in biodiversity in general. Primary techniques utilised will be tubestock installation to ensure accurate composition is obtained as well as manipulation of regrowth on-Site.	Benefits associated knowledge and extent of EVNT species on publically-managed estate. Allows tight controls over biodiversity. Will hopefully allow dispersal of key species over Site. Results will be apparent in short timeframes.	Requires research on EVNT species to ensure location and installation techniques are appropriate. Resource intensive.				✓	✓	

4.2 Adaptive Management Processes and Trials

To avoid critical time lags and unnecessary resource allocation, rehabilitation techniques will require some experimentation to determine more precisely the outcomes of different vegetation management, fire, hydrologic and micro-topographic manipulations upon vegetation development.

Adaptive approaches allow for mid-course revisions or changes to the management or restoration program based upon an improved understanding of a system provided through monitoring. This is particularly appropriate in large-scale restoration or rehabilitation projects where our understanding of how the system will respond to rehabilitation treatments is incomplete (often the case with highly disturbed land).

Adaptive management of land rehabilitation relies upon a number of key elements including:

- The setting of clear goals that can be easily assessed in a monitoring program;
- Implementing, testing and assessing different rehabilitation methods and techniques as part of the rehabilitation process;
- A monitoring program that provides information that increases our understanding of the ecosystem and its development;
- The use of monitoring information to assess performance indicators and whether goals are likely to be met; and
- The use of monitoring information as feedback to guide any necessary changes to the management plan.

Figure 12 provides a recommended structure for the introduction of adaptive management processes to project workflow:

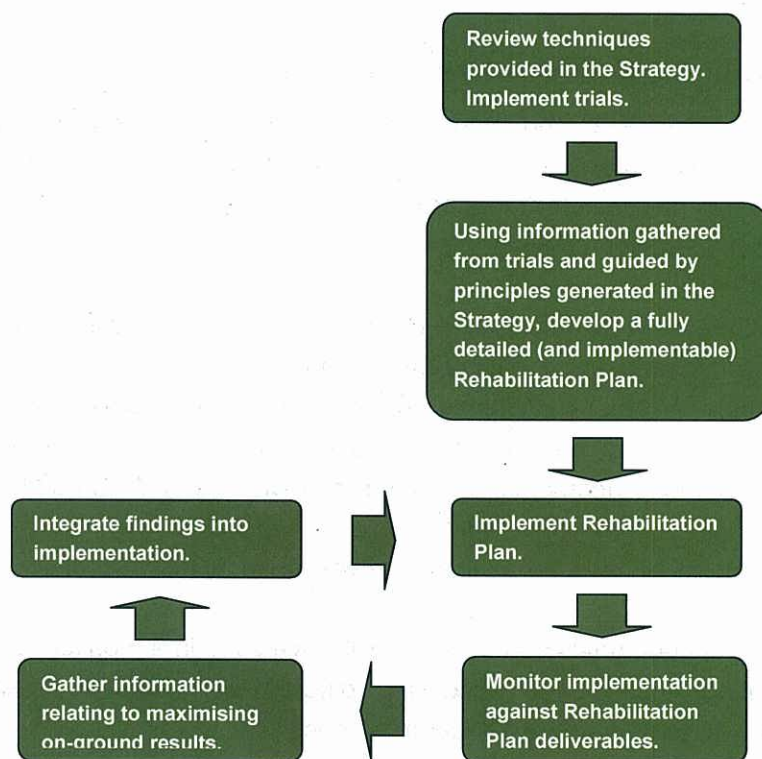


Figure 12 Suggested Project Adaptive Management Processes

Adaptive management allows for the setting of transparent goals, relevant performance indicators and a monitoring program that will allow rapid determination of whether rehabilitation targets are being met.

Such processes will ultimately allow for the testing and development of superior rehabilitation methods and treatments that can be used on Site and for other regional rehabilitation projects. A greater understanding of remnant management, habitat enhancement and ecosystem functioning in coastal lowland ecosystems will result using this approach.

4.2.1 Trial Usage in Adaptive Management Process

As little is known regarding broadscale application of techniques, a key part of pre-plan finalisation will be confirming the sustainability of target communities followed by undertaking of vegetation management trials targeting key communities to be restored.

In terms of risk the following techniques have been identified (ranked in order from lowest to highest):

1. Remnant enhancement;
2. Regrowth management;

3. Tubestock installation;
4. Enhanced regeneration in clean areas;
5. Direct seeding;
6. Enhanced regeneration in areas dominated by setaria and other improved pastures.

Given the extent of vegetation and the risks associated with the various techniques, prioritised trials should be focused on investigating the impacts of key management techniques (4, 5 and 6).

Appendix C outlines the scope and parameters for these trials while Section 4.3 outlines integration methods for this critical step in information gathering.

Further on site investigations are being undertaken in relation to the Public Environmental Report being prepared for the environmental approval under the EPBC Act. Adaptive management approaches will also need to investigate the findings of these investigations and outcomes of the Federal Environmental Approval Process.

4.3 Proposed Project Sequence

The following sequence is recommended for current works, restoration plan development and on-ground implementation stages. The sequence should be followed in order to maximise results and minimise project expenditure and time constraints. VMU management will be timed in lieu of the proposed Stage Development Strategy.

Table 7 Proposed Project Stages and Sequence

Project Stage	Deliverable	Potential Approval Scope	Requirements / Additional	Anticipated Project Initiation.	Years from
Pre Rehabilitation Plan Development (current stage)	1. Halt chopper rolling of regrowth in all VMUs indicated within this plan unless deemed necessary for mound / stump removal and pine regrowth management;				0-3
	2. Engage with local environmental groups to cement local knowledge and maximise environmental outcomes;	Rehabilitation Stakeholder Engagement Plan.			
	3. Develop and implement a Weed Management Strategy focussing on Class 2 <i>Sporobolus</i> species within the development area;	Greening Australia to be engaged for these deliverables.			
	4. Maintain seed collection of seed from sites as recommended in Appendix B, focusing on orthodox framework, shrub and groundcover	Seed collection permits may be required for EVNT species. Tendering will be required for seed collection works.			

Project Stage	Deliverable	Potential Approval Requirements / Additional Scope	Anticipated Years from Project Initiation.
	species (in that order) of the community RE 12.3.5 (dry and wet conditions) and other VMU REs as listed in Table 3;		
	5. Align fire management activities with objectives outlined within this Strategy, focusing on ecologically-sustainable burnings within remnant areas while reducing fuel loads and excluding fire from areas earmarked for regrowth management;	Permits issued by the Queensland fire and Rescue Service will be required for operational burning when undertaken. Contractors may be required to plan for and deliver burning activities.	
	6. Commence hygiene procedures for site machinery focusing on only allowing machinery free of setaria and other highly invasive or declared seed into rehabilitation areas. Consider starting initial treatments in "green" (initial remnant enhancement areas) as outlined in Appendix A;	DERM-administered permits may be required for treatment of weeds in riparian areas.	0-1
	7. Fence riparian lines and either provide off-stream watering points or specific areas not prone to	Fencing contractors may be required for fence installation.	1-4

Project Stage	Deliverable	Potential Approval Requirements / Additional Scope	Anticipated Project Initiation	Years from
	erosion for cattle access;			
	8. Commence crash grazing of areas earmarked for rehabilitation that are dominated by improved pastures, particularly setaria (see Appendix A); and		1-5	
	9. Withdraw cattle from all rehabilitation areas where palatable grasses offer little competition to regrowth.			
Rehabilitation Plan Development	1. Identify best available, locally occurring, representative target community reference sites. These reference sites will be utilised to create key targets for each VMU type apart from Remnant Enhancement;	Consultancies to develop additional information will be required.	1-5	
	2. Commence trials of key techniques in areas outlined in Appendix C;	Vegetation contractors will be required for trial design, implementation and monitoring.		
	3. Monitor key Regrowth Management	Consultancies to develop additional information will		

Project Stage	Deliverable	Potential Approval Scope	Requirements / Additional	Anticipated Years from Project Initiation.
	and Assisted Regeneration VMUs every six months to record regrowth and key weed species/threatening process behaviour /characteristics; and	be required.		
	Use information from trials and monitoring to identify successful techniques and restructure the information presented in this Strategy into a fully developed restoration plan taking into account the learnings of the trials (see Section 4.3.1).	Consultancies to develop additional information will be required.		2-7
		Vegetation contractors will be required for implementation and reporting.		2-7
Plan Implementation	1. Following stakeholder consensus, implement the established plan over the remainder of the VMUs. Utilising the "traffic light" system provided in the VMU treatment table / Figure 11, undertake management of "Green" and "Orange" management units. Ensure that adaptive management processes are in	Vegetation contractors will be required for implementation and reporting.		2-10

Project Stage	Deliverable	Potential Approval Requirements / Additional Scope	Anticipated Years from Project Initiation.
	place to maximise on-ground benefits and minimise risk. Where possible, aim to commence works within upstream areas and work downstream when developing restoration plan timing.		
	2. As above undertake installation of "Red" (low priority) management units	Vegetation contractors will be required for implementation and reporting.	5-15
	3. Monitor results to plan specifications; and utilise adaptive management process outlined in Figure 12.	Consultancies to report on project success will be required.	10-20

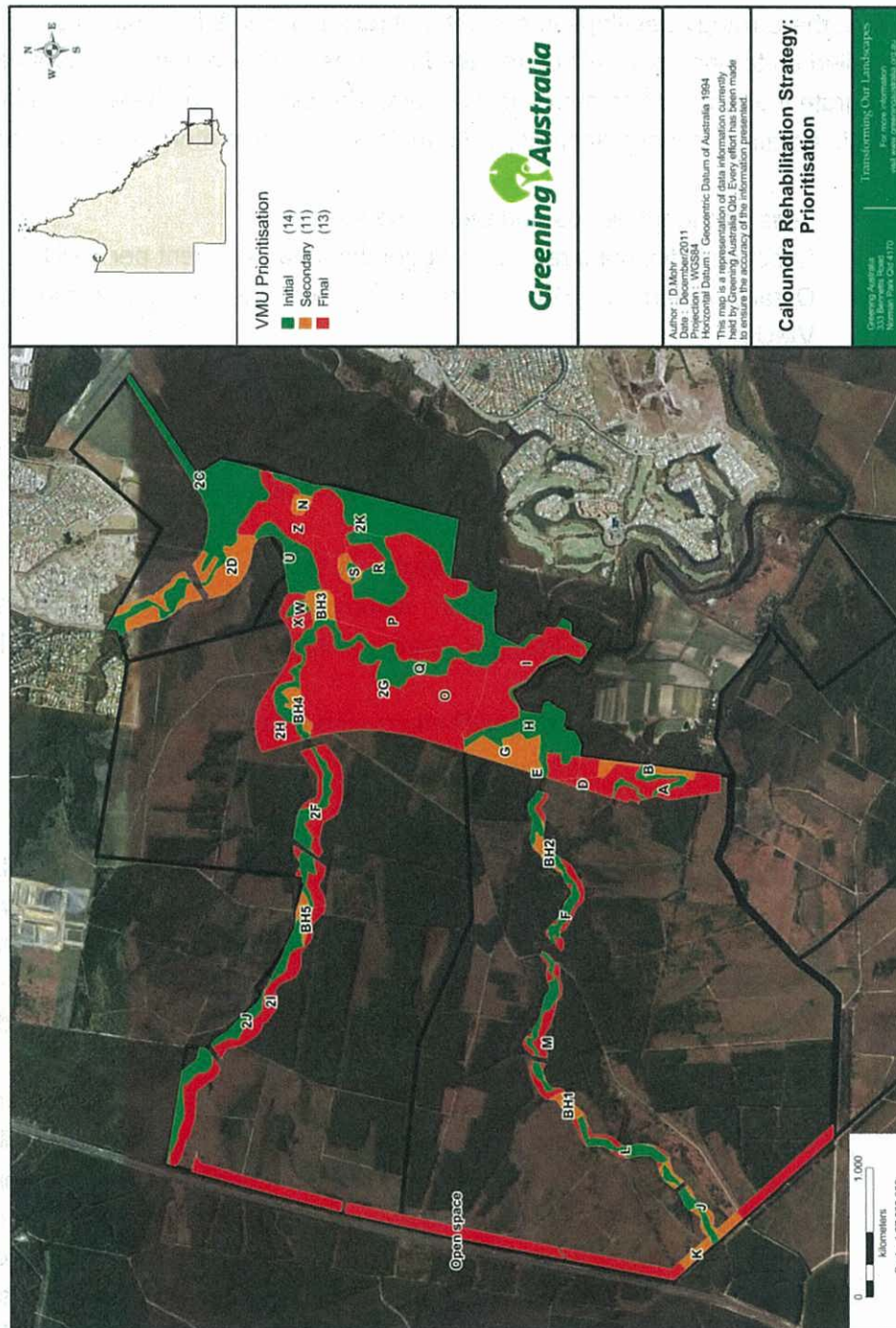


Figure 13 Strategy VMU Prioritisation

4.3.1 Ecological Rehabilitation Plan

While the Strategy develops important umbrella principals for restoration of the Site, a detailed restoration plan will be required to further develop these concepts as well as integrate trial results and more current data. The plan is to be based on this Strategy, with integration of trial outcomes, but should also include more detail regarding:

- Less dominant weeds and their control;
- Exact specifications regarding vegetation management per VMU;
- Details regarding EVNT flora/fauna recommendations within each Biohub VMUs;
- Up-to-date assessments of regrowth on-Site (undertaken as soon as possible to release of the plan);
- Reference site information with clearly defined targets that focus on attaining remnant status but also cover other issues such as weed extent and shrub/groundlayer condition;
- Monitoring specifications (see Section 4.3.1.1);
- Soil testing and amelioration recommendations for installation of VMUs (recommended one test per reference site and one test per 50 hectares for target VMUs); and
- Hydrology realignment specifications where appropriate.

4.3.1.1 Monitoring

Remnant status data from the canopy (the ecologically dominant layer) will be used to make comparisons with reference sites to determine remnant status. While a more detailed monitoring program should be delivered as part of the ecological restoration plan, the following should be considered within the monitoring program:

- Monitoring should be undertaken twice yearly, preferably at the end of summer and the end of winter;
- Fixed transect monitoring of native vegetation cover, height, richness and composition from within each ecological layer of the community will take place annually. This element should form the foundation of monitoring and needs to study the Site's flora assemblage in relation to representative reference ecosystems, as well as the coverage of key functional groups necessary for the continued development and/or stability of the restored ecosystem. The Biocondition Assessment methodology developed by DERM could form a major component of this element;
- An unbounded floral survey conducted annually to report the presence and abundance of all floral and faunal species on the site; and
- Other observational data will include the presence and condition of erosion, details on the presence and mapped extent of any declared or severe

environmental weeds and the presence and extent of any observed threatening processes.

5 Discussion

This Ecological Rehabilitation Strategy provides a site wide approach to the rehabilitation for Caloundra South. It is intended that this report be used to guide and inform more detailed investigations and approaches to rehabilitation of the site. This will enable:

1. Provision of reliable specifications for rehabilitation of VMUs as outlined in this Strategy;
2. Further development of VMU techniques and objectives and ground testing of cleared areas to obtain regeneration / regrowth potential of the site;
3. Further understanding of hydrological works which may facilitate the installation of heath and ponded wetland communities;
4. The investigation of opportunities to coordinate research of the on-ground component of works by university-based ecologists. Key elements for research bodies to explore are the advantages and disadvantages of tubestock and direct seeding technologies and success criteria for corridors and core habitat areas.

6 Conclusion

The rehabilitation of the Site provides not only an opportunity to reinstate key coastal habitat, but also allows restoration ecology researchers to investigate the effects of such work at a scale rarely seen in Queensland. The Rehabilitation Plan proposed within this report, when implemented, will also provide large scale, restoration buffering for three of the largest local creeks in the area.

The Strategy aligns with the Caloundra South Conservation Strategy (ARUP, Dec 2011) and identifies key guidelines for restoration of the Site (including resilience and site trajectories) and provides guiding principles for rehabilitation based on these key elements.

The Strategy outlines various treatments (dominated by regrowth management and revegetation) for over 592 hectares of vegetation dominated by melaleuca wetlands, but including other elements such as rainforest and eucalypt forest. This restored area represents approximately 25% of the entire proposed development site, with seed collection activities currently underway.

As a preliminary document, the Strategy provides a key starting point for developing the rehabilitation of the Site, and will allow for the clear and rapid development of a site restoration plan.

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8 Appendix A: VMU CHARACTERISTICS AND OBJECTIVES

The following figures outline key characteristics on-site including remnant vegetation extent, preclearing data and VMU extent.

The following table lists VMU characteristics as observed during the May 2010 survey and subsequent desktop review.

Table 8 VMU Characteristics

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds) : grass density	Biotic blocks to succession (weeds) : shrub / other
A	4.0	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant	As remnant	As remnant		None noted.	Mature and wildling pines - dense.
B	4.0	12.3.5	12.3.5 (wet)	Paperbark dominated swamp	Regrowth management	High	As remnant	As remnant	As remnant	Power easement to south.	None noted.	Mature and wildling pines - dense.
C	24.7	12.3.5	12.3.5 (wet)	Paperbark dominated swamp	Assisted regeneration	Medium	Currently appears to have low M.quinquervia coverage (recently cleared) but may have high potential.	Currently appears to have low Melastoma sp and Acacia sp coverage (recently cleared) but may have high potential.	Has fair coverage of native sedge and rush species.	Power easement to south.	Signal grass over 70% of area. Limited setaria.	Limited pine wildlings / grazing.

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other
D	2.2	12.3.5	12.3.5 (dry)	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	Medium	Currently appears to have low <i>M. quinquevittata</i> coverage (recently cleared) but may have high potential.	Currently appears to have low <i>Melastoma</i> sp and <i>Acacia</i> sp coverage (recently cleared) but may have high potential.	Has fair coverage of native sedge and rush species.	Appears to have been mounded and may require direct seeding of 80% of area to obtain framework coverage.	Signal grass over 70% of area. Limited <i>setaria</i> .	Limited pine seedlings / grazing.
E	0.6	12.3.5	12.3.5 (dry)	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	Medium	Currently appears to have low <i>M. quinquevittata</i> coverage (recently cleared) but may have high potential. There is higher levels of regeneration to the west. Currently little need for thinning.	Currently appears to have low <i>Melastoma</i> sp and <i>Acacia</i> sp coverage (recently cleared) but may have high potential.	Has fair coverage of native sedge and rush species.	Appears to have been mounded and may require direct seeding of 80% of area to obtain framework coverage.	Signal grass over 70% of area. Limited <i>setaria</i> .	Limited pine seedlings / grazing.
F	10.7	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant	As remnant	As remnant		None noted.	Mature and wilding pines.

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds) : grass density	Biotic blocks to succession (weeds) : shrub / other
G	11.1	12.3.5	12.3.5 (dry)	Paperbark / Forest Red Gum riparian habitat	Regrowth management	High	80% <i>M.quinquineria</i> / <i>L.suaveolens</i> coverage at average 1m height.	Medium <i>Acacia sp</i> and <i>A.littoralis</i>	Has fair coverage of native sedge and rush species.		Whiskey grass 10%.	
H	23.2	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant	As remnant	As remnant	Has been overburnt and lacks some coverage in areas.	None noted.	Mature and wilding pines.
I	27.2	12.3.5/14	12.3.5/14	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	Medium	5-20% <i>M.quinquineria</i> / <i>L.suaveolens</i> coverage at 30cm high.	Medium <i>Acacia sp</i> and <i>A.littoralis</i>	Has fair coverage of native sedge and rush species and bladey grass to the south.		setaria (low)	<i>Acacia sp.(low)</i>
J	4.2	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant with higher proportion of <i>E.racemosa</i> .	As remnant	As remnant		None noted.	Mature and wilding pines - dense.
K	6.2	12.3.5	12.3.5 (dry)	Paperbark / Forest Red Gum riparian habitat	Regrowth management	Medium	5% <i>M.quinquineria</i> coverage at 1m high.	<i>Melastoma sp.</i> , <i>Glochidion sp.</i> , <i>A.littoralis</i> , <i>A.excelsa</i> .	Native sedges and braken		signal grass (low)	Low pine wildings and lantana.
L	5.7	12.3.5	12.3.5 (unmapped remnant)	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	Higher proportion of <i>E.racemosa</i> .	As remnant.	As remnant.		low para grass	low lantana

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds): shrub / other	Biotic blocks to succession (weeds): grass density
M	8.3	12.3.5	12.3.5 (dry)	Paperbark / Forest Red Gum riparian habitat	Installation	Low	Very limited.	Very limited.	Very limited.		Low pine wildlings and lantana.	Mix of improved pastures including signal grass (70%)
N	2.0	12.3.13	Unable to inspect although may be 12.3.13	Heath	Assisted regeneration	Unable to inspect.	Unable to inspect.	Unable to inspect.	Unable to inspect.	Unable to inspect.	Unable to inspect.	Unable to inspect.
O	21.4	12.3.5	12.3.5/14 (dry)	Paperbark / Forest Red Gum riparian habitat	Installation	Medium	5% coverage at 30cm high.	low			Acacia sp. (low)	setaria (70%)
P	65.6	12.3.5/14	12.3.5/14	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	Dependant of level of inundation and extent of improved pasture.	M. quinervia coverage at 1m high improves to the east	Improves to the east.	Has good coverage of native sedge and rush species to the east			setaria to the west
Q	32.7	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant - higher proportion of scribbly gums.	As remnant	As remnant		Low lantana, low levels of pine / wildling cover.	None noted.

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds) : grass density	Biotic blocks to succession (weeds) : shrub / other
R	13.2	Remnant (+regrowth)	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement / regrowth management	High	As remnant.	As remnant.	As remnant.		setaria (40% cover)	Low pine.
S	1.1	Remnant	12.3.1	Lowland rainforest	Remnant enhancement	High	As remnant.	As remnant.	As remnant.		Low setaria on edges	Low lantana and pine. While native to this community, the medium coverage of eucalypt / melaleuca may pose a threat in terms of more flammable vegetation
T	2.0	12.3.1	12.3.1	Lowland rainforest	Regrowth management, installation.	High	South is dominated by regrowth of RF species while north is shrub species only.	As remnant.	As remnant.		Low setaria on edges	Low lantana and pine. While native to this community, the medium coverage of eucalypt / melaleuca may pose a threat in

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other
U	11.4	Remnant	12.9-10.14	Blackbutt open forest,	Remnant enhancement	High	As remnant.	As remnant.	As remnant.		Small patch of Singapore daisy to north on track.	terms of more flammable vegetation
W	1.6	Remnant	12.3.13	Heath	Remnant enhancement	High	As remnant.	As remnant.	As remnant.		Whiskey grass 10%.	Low pine wildlings.
X	5.0	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	Medium - poor	Poor - fair Melaleuca coverage	Poor	Poor		Almost 100% setaria coverage	
Z	27.0	12.3.6	12.3.6	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	High	Fair Melaleuca coverage. No E.tereticornis observed (but required) although it may be present.	High	High	Recently cleared - difficult to gauge full extent of seedbank	Whiskey grass 10%.	

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds) : grass density	Biotic blocks to succession (weeds) : shrub / other
2C	38.5	Remnant	12.3.5, 12.3.6	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant.	As remnant.	As remnant.			Low lantana / pine.
2D	19.0	12.3.6	12.3.6	Paperbark / Forest Red Gum riparian habitat	Assisted regeneration	High	Adequate coverage of Melaleuca and E.tereticornis	High	Low		setaria, whiskey grass and signal at 50% coverage	Limited pine wildlings.
2F	14.4	Remnant	12.3.5	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant.	Fair	Fair		10% setaria coverage	Limited lantana (5%)
2G	68.9	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Regrowth management / installation	Unknown	Melaleuca is present but its coverage ranges from poor to adequate.	Poor (some acacias)	Poor		Improved pastures are dominant in most areas.	Limited mature / wilding pines.
2H	23.0	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Regrowth management / installation	Unknown	Melaleuca is present but its coverage ranges from poor to adequate.	Poor (some acacias)	Poor		Improved pastures are dominant in most areas.	Limited mature / wilding pines.

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds) : grass density	Biotic blocks to succession (weeds) : shrub / other
2I	18.9	12.3.4	12.3.4	Paperbark / Forest Red Gum riparian habitat	Regrowth / management / installation	Unknown	Melaleuca is present but its coverage ranges from poor to adequate. No E.robusta observed (will require introduction)	Poor (some acacias)	Poor		Improved pastures are dominant in most areas.	Limited mature / wildling pines.
2J	13.5	Remnant	12.3.4	Paperbark / Forest Red Gum riparian habitat	Remnant enhancement	High	As remnant although E.robusta was not observed.	As remnant	As remnant			Low lantana and pine wildlings / saplings.
2K	27.5		12.3.8, 12.3.12, 12.3.5	Paperbark / Forest Red Gum riparian habitat /	Remnant enhancement	High	As remnant	As remnant	As remnant			Low lantana and pine wildlings / saplings.
BH1	2.3	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Biohub	Moderate - high					None noted.	

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other
BH2	2.2	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Biohub	Moderate - high					None noted.	
BH3	4.5	12.3.13, 12.3.5, 12.9-10.14	12.3.13, 12.3.5, 12.9-10.15	Paperbark / Forest Red Gum riparian habitat /	Biohub	Moderate - high					None noted.	
BH4	2.9	12.3.5	12.3.5	Paperbark / Forest Red Gum riparian habitat	Biohub	Moderate - high					None noted.	
BH5	2.7	12.3.4	12.3.4	Paperbark dominated swamp	Biohub	Moderate - high					None noted.	

VMU	Approx. area (Ha)	Preclearing RE	Target RE	Corresponding habitat as per Conservation Strategy (ARUP, Dec 2011)	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Seedbank resilience	Frame cover / key species	Shrublayer / key species	Groundcover / key species	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other
Open Space Buffer (west)	39.0	12.3.5/12.3.14/12.3.13/12.9-10.22 / 12.9.4	12.3.5/12.3.14/12.3.13/12.9-10.22 / 12.9.5	Paperbark / Forest Red Gum riparian habitat / Heath / unclassified eucalypt forest community	Installation (recreational area with additional habitat benefit using native species).	Area not surveyed	Area not surveyed	Area not surveyed	Area not surveyed	Area not surveyed	Area not surveyed	Area not surveyed

Table 9 VMU Rehabilitation Prioritisation

VMU	Priority (Red = low priority, Green = high priority, Amber = moderate priority)	Approx. area (Ha)	Target Community	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other	Site-specific suggested treatments	Estimated number of tubestock required	Estimated Direct Seeding required (km)
A		4.0	12.3.5	Remnant enhancement		None noted.	Mature and wildling pines - dense.	None noted.		
B		4.0	12.3.5 (wet)	Regrowth management	Power easement to south.	None noted.	Mature and wildling pines - dense.	None noted.		
C		24.7	12.3.5 (wet)	Assisted regeneration	Power easement to south.	Signal grass over 70% of area. Limited setaria.	Limited pine wildlings / grazing.	None noted.	5340	5.34
D		2.2	12.3.5 (dry)	Assisted regeneration	Appears to have been mounded and may require direct seeding of 80% of area to obtain framework coverage.	Signal grass over 70% of area. Limited setaria.	Limited pine wildlings / grazing.	None noted.	440	0.44

VMU	Priority (Red = low priority, Green = high priority, Amber = moderate priority)	Approx. area (Ha)	Target Community	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other	Site-specific additional suggested treatments	Estimated number of tubestock required	Estimated Direct Seeding required (km)
E		0.6	12.3.5 (dry)	Assisted regeneration	Appears to have been mounded and may require direct seeding of 80% of area to obtain framework coverage.	Signal grass over 70% of area. Limited setaria.	Limited pine wildlings / grazing.	None noted.	160	0.16
F		10.7	12.3.5	Remnant enhancement		None noted.	Mature and wildling pines.	None noted.	2280	2.28
G		11.1	12.3.5 (dry)	Regrowth management		Whiskey grass 10%.		None noted.	1100	1.1
H		23.2	12.3.5	Remnant enhancement	Has been overburnt and lacks some coverage in areas.	None noted.	Mature and wildling pines.	None noted.		
I		27.2	12.3.5/14	Assisted regeneration		setaria (low)	<i>Acacia</i> <i>sp. (low)</i>	None noted.	5600	5.6

VMU	Priority (Red = low priority, Green = high priority, Amber = moderate priority)	Approx. area (Ha)	Target Community	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other	Site-specific additional suggested treatments	Estimated number of tubestock required	Estimated Direct Seeding required (km)
J		4.2	12.3.5	Remnant enhancement		None noted.	Mature and wilding pines - dense.	None noted.		
K		6.2	12.3.5 (dry)	Regrowth management		signal grass (low)	Low pine wildings and lantana.	None noted.	680	0.68
L		5.7	12.3.5 (unmapped remnant)	Remnant enhancement		low para grass	low lantana	None noted.		
M		8.3	12.3.5 (dry)	Installation		Mix of improved pastures including signal grass (70%)	Low pine wildings and lantana.	Soil stimulation / fire / direct seeding.	1880	1.88
N		2.0	Unable to inspect although may be 12.3.13	Assisted regeneration	Unable to inspect.	Unable to inspect.	Unable to inspect.	Spot thinning of framework plants / competitive species around framework species.	200	0.2
O		21.4	12.3.5/14 (dry)	Installation		setaria (70%)	<i>Acacia sp. (low)</i>	Direct seed with dry 12.3.5 mix over most of site.	21400	17.12

VMU	Priority (Red = low priority, Green = high priority, Amber = moderate priority)	Approx. area (Ha)	Target Community	Zone Type - recommended treatment (Installation / assisted regen / regrowth man/ remnant enhancement)	Other conditions	Biotic blocks to succession (weeds): grass density	Biotic blocks to succession (weeds): shrub / other	Site-specific additional suggested treatments	Estimated number of tubestock required	Estimated Direct Seeding required (km)
P		65.6	12.3.5/14	Assisted regeneration		Setaria to the west		None noted.	13120	13.12
Q		32.7	12.3.5	Remnant enhancement		None noted.	Low lantana, low levels of pine / wilding cover.	None noted.		
R		13.2	12.3.5	Remnant enhancement / regrowth management		Setaria (40% cover)	Low pine.	Pine control plus setaria control after adjacent areas have reached 2m high.		
S		1.1	12.3.1	Remnant enhancement		Low setaria on edges	Low lantana and pine. While native to this community, the medium coverage of eucalypt / melaleuca may pose a threat in terms of more flammable vegetation	Weed control plus eucalypt / melaleuca thinning.		