4. Rehabilitation priorities on the Central Plateau

In Chapter 2 we presented priority classes for rehabilitation on the Central Plateau. Assigning sites to these classes depends upon knowledge of:
1. the present condition of the area,
2. the conservation value of the area,
3. the trajectory of the area, and
4. the cost and probability of success of appropriate rehabilitation techniques.

4.1.1. Identification of priority areas

Table 4 below summarises the progress towards identifying sites in each of the priority classes used in this report. Given the results available at this point, no areas that clearly fall within any of the priority categories can be identified.

Table 4. Rehabilitation priorities identified to date.

Priority	Sites
Priority One: Protection of large areas with high ecological integrity that have not suffered erosion, but are threatened by degradation in neighbouring environments.	Despite searching for this category of site, no large areas with intact soils that are threatened by soil erosion have been identified.
Priority Two: Protection of areas that support significant soils, landforms, threatened species or communities, and that are threatened by erosion related disturbance.	No systematic search has yet been made for these features. Further work is likely to identify many such sites.
Priority Three: Partially degraded areas that still retain some conservation value but are actively deteriorating or not recovering naturally.	Many sites potentially fall into this category.
Priority Four: Areas where rehabilitation is likely to fail because there is no known effective rehabilitation technique.	Many sites that would otherwise be Priority 2 or 3 fall into this category.
Priority Five: Areas where rehabilitation is likely to fail because of the extent of degradation.	Many sites fall into this category, in particular large contiguous areas of severe or extreme erosion where only shallow gravelly soils remain. These sites are mostly in the periglacial regions of the Plateau, and include areas at Bernacchi and Wild Dog Tier.
Priority Six: Partially degraded areas that still retain some conservation value and are recovering naturally.	Many sites potentially fall into this category, including areas south of Lake Augusta, some sites on Double Lagoon Road and some sites near Pine Lake.

Significant progress has been made towards identifying priority areas on the Plateau. Cullen's 1995 mapping has been found to be a good indication of areas where erosion may be active. However, in other areas considerable work is required to produce the required information. A search for conservation values is relatively straight forward, although time consuming. Monitoring the trajectory of soil erosion and trialing rehabilitation techniques are both very difficult tasks. Previous attempts have yielded only tentative results, that cannot be interpreted with confidence or extrapolated beyond the immediate environment involved in the trials. Significant work will be needed in these areas to produce the information that will enable priority areas to be identified.

The obvious conclusion is that at present, we do not have a good enough understanding of the distribution and behaviour of erosion on the Plateau to make any judgments as to what the priority actions for rehabilitation should be. In this circumstance, it is important to gather the information to make those judgements on an informed basis, rather than risking significant waste of money and resources by initiating rehabilitation works now.

5. Conclusions

The following conclusions can be drawn from the work completed on the Central Plateau:

1. The Plateau is a remote area with a harsh environment that supports a wide variety of conservation values, relating in part to special flora, fauna and geo features, and also to the ecosystem integrity of the area.
2. There is extensive degradation (apparent as bare ground) on the higher parts of the plateau, related to the history of European land management.
3. In 1990, 11,000 hectares of the Plateau were impacted by some degree of degradation (apparent as bare ground), with a further 20,000 ha within 100 m of disturbed ground and so potentially at risk of future damage should erosion spread.
4. Areas of bare ground are susceptible to continuing erosion by a wide variety of processes, of which frost heave may be the most important.
5. Degraded areas may recover stability in the form of the return of a complete vegetation cover (although this does not necessarily represent a recovery of the original soil and vegetation character).
6. A prioritisation scheme is presented that will allow land managers to classify the Plateau into areas that reflect pragmatic rehabilitation priorities that will maximise outcomes for the conservation values of the Plateau, and avoid wasting money and resources on areas where rehabilitation is futile.
7. Applying the prioritisation scheme requires knowledge of the location of conservation values, the present landscape condition, trajectory of that condition, and the cost and probability of success of appropriate rehabilitation techniques.
8. The exiting erosion mapping is an acceptable estimate of the present condition of areas that presently are degraded. However, it does not indicate which areas have been degraded in the past and have recovered a complete vegetation cover.
9. The distribution of conservation values relative to degradation is presently unknown.
10. The rate at which either ongoing erosion or vegetation recovery is occurring is likely to vary both spatially and temporally, and at present is largely unknown.
11. Rehabilitation techniques that have been used on the Plateau are successful only in a small range of environments, and do not appear to work well in badly sheet eroded areas.
12. If rehabilitation is to be attempted in areas suffering significant sheet erosion or channel erosion, new techniques must be identified to achieve this.
13. At present we lack the information required to identify any of the rehabilitation priorities.
14. In this situation, this document cannot recommend any rehabilitation works commence at this stage. Rather, it is important to gather the information required to clearly identify rehabilitation priorities (ie the areas condition, conservation value, trajectory and likely rehabilitation cost and probability of success).

6. Future directions

Through the course of this project it has become apparent that the ongoing erosion problems on the Central Plateau are complex, and any large scale management response will be expensive, complicated and have uncertain outcomes. In this situation, it is important to develop a strategic approach to the problem that identifies the most appropriate routes forward in a framework that allows for adaptation as more information becomes available. The priority classes presented in this report are an important component of such a rehabilitation strategy. However, as was described in the Chapter 4, the present state of knowledge is not sufficient to identify priority areas in any meaningful way. For this to occur, more information must be collected on condition, conservation values, trajectory and potential for rehabilitation.

Rates of change on the Plateau appear to be slow but inexorable. This is both a hindrance and a comfort to the land manager. On the one hand, measurements of trajectory and of rehabilitation success may require five to ten years to produce a meaningful result. On the other hand, because rates of soil loss are slow, we can afford to delay rehabilitation until the time when there is more confidence in judgements of where rehabilitation is necessary and what can be done.

The section below outlines the work that needs to be completed in order to apply the prioritisation with confidence. Note that this is purely intended to inform the prioritisation of areas, not to be a strategy for rehabilitation on the Plateau which would need to consider a much wider range of issues.

Survey of special values potentially threatened by erosion

- Use fieldwork, aerial photography and desktop analysis of existing data to list and map special conservation values relating to geoconservation, threatened species and vulnerable communities. Particular emphasis should be placed on values that are potentially threatened by soil erosion because of either their location or their sensitivity.

Measurements of site trajectory.

- Develop a regionally based classification of eroding landscapes that can be used to structure measurements of site trajectory.
- Develop a robust and repeatable monitoring method that will allow accurate measurement of small rates of soil loss or gain and changes in vegetation cover over decade time spans. This may be based on remote sensing or on field surveys.
- Apply monitoring methods in a program designed to target different environments, including some of the special values identified above.
- Revisit existing vegetation monitoring sites and re-analyse data to identify patterns in control plots. Also, improve methods of marking quadrat sites so that monitoring can continue into the future.

Review and trialing of rehabilitation techniques.

- Review alpine and subalpine zone rehabilitation techniques used interstate and internationally.
- Continue monitoring existing experimental rehabilitation techniques.
- Within the context of the regionally based classification of eroding landscapes, develop a plan to extend rehabilitation trials to a broader range of environments and techniques.
- Make sure an appropriate robust and repeatable monitoring program is included in these experiments so that results can be clearly and scientifically evaluated.

The order in which these tasks should be undertaken should reflect where the results are necessary to inform later steps, and the investment of time that is required to complete the task. The special values survey is a priority, because the results of this will have some influence on the choice of environments where erosion trajectory should be monitored, and where rehabilitation trials should be developed. However, it is also important to establish monitoring sites and rehabilitation trials as soon as possible. This is because slow and variable rates of change mean that at least five years will be required before meaningful measurements can be made. Until results from this work are available, it is not possible to tell the degree to which rehabilitation on the Plateau is urgent (priority classes one to three) or the degree to which it has a less obvious claim on conservation resources (priority classes four to six).

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8. Appendices

8.1. Appendix 1: Definitions of terms used in field sheets

1. Soil condition in terms of moisture (1-5) and frost (1-2)
   1= dry, **2**=moist, **3**=wet, **4**=standing water, **5**=overland flow
   1=no frost, **2**=frost
2. Topography:
   crest = local high point, convex upward
   slope = planar sloping area that isn't crest or depression.
   - **Upper** – less than 100 m to ridge or crest
   - **Middle** – between 100 and 400 m to crest
   - **Lower** – greater than 400 m to crest

   flat = planar non sloping area
   bowl depression = dish shaped depression that concentrates flow but has an outlet
   open depression = valley/drainage line
   closed depression = has no exit
3. Size of degraded area:
   small < 50 m diameter, **medium** < 1 ha, large > **1 ha**
4. Degree of erosion (1-5)
   1 = major:. Areas of eroded soil large and interconnected. Remnant soil exists as pedestals. Erosion has extended to some erosion resistant level such as rock or gravelly erosion pavement
   3= moderate: Areas of remnant soil and erosion roughly equivalent. Eroded patches large. Erosion typically exposes B horizon.
   5 = minor: Areas of remnant soil large and interconnected. Eroded patches are discrete depressions. In eroded patches there remains significant depth of soil, probably including some A horizon
5. Glacial and periglacial landform options:

VE	valley glacier erosional	**IH**	icecap hummocky moraine
VM	valley glacier moraine	**PS**	Periglacial slope deposits
IE	icecap erosional area	**PP**	relict periglac patterned ground
IT	icecap terminal and recessional moraines		

6. Describe veg in terms of community type, structure and dominant species
7. Inundation and moisture retention index
   1. **Long term inundation** – pools contain water consistently through the wetter months and into the dry season. Pools occur in deep (over 20 cm) depressions in soil of low to moderate hydraulic conductivity. Depressions are relatively small, especially if there is a slope, which means that they can hold a significant depth of water. The site receives water from surface and subsurface flow, which maintains water levels in pools for long periods after rain. Floor of pools devoid of vegetation or may have sparse aquatic veg.
   2. **Medium term inundation** – pools hold water for a significant period after rain, but will dry out. Soil depressions are either shallow or large, meaning that standing water is often shallow. Soils typically have moderate to low hydraulic conductivities, so that stored water does not drain rapidly. Pool floors typically devoid of vegetation.
   3. **Short term inundation** – pools formed in shallow surface depressions, likely to hold water for only short periods after rain. Walls of pools likely to have moderate to high hydraulic conductivity. Pools drain in a few days after rain ceases, but by remain full for considerable periods when there is regular rainfall. Floor of pool may be partially vegetated with lichen or moss.
   4. **Moisture retaining soil**. Soil depth moderate to deep. No pools form because of a lack of suitable micro-topography. Soil texture will sufficient clay and/or organic material to hold soil water. Soil will remain moist for a significant time once saturated.
   5. **Rapidly draining soil that receives surface and subsurface drainage**. Soils shallow, gravelly and free draining. Local topography is such that although water does not pool, surface and shallow subsurface drainage is concentrated through this area. Thus, this area will remain moist for longer than surrounding shallow soils after rain. Will be dry for the bulk of the dry season.
   6. **Rapidly draining soil with no catchment**. Soils shallow and gravelly. Area does not receive concentrated overland flow or significant subsurface flow. Will dry out rapidly between rain events.

8. Soil type: circle dominant types and if necessary indicate where it occurs eg remnants only
peat = organic rich, dark brown to black colour
in-situ Jd/Tb = yellow orange to red gradational soils, lots of stone fragments, clayey texture to B horizon, on dolerite or basalt
aeolian = usually near an obvious sand source (ie lunette), dominated by sand sized particles
alpine humus = fine soils, usually brown in colour, often found along drainage lines and associated with grasslands
other – specify

9. Erosion boundary

	type 1 – abrupt	**type 2 - moderate**	**type 3 - diffuse**
slope of soil scarp	very steep to vertical or overhanging	moderate to gentle	gentle – scarp top may be ill defined and blend in with remnant patch
height of soil scarp	scarp usually over 10 cm high. Toe of scarp is below base of A horizon.	low to high	low to high
veg	Veg cover very low, mainly from overhanging plants rooted in the remnant soil above. No veg rooted in scarp face.	Veg overhangs face, some veg grows on face, but bare patches still occur. Veg boundary sometimes extends into the eroded area	Over 80% veg cover on scarp. Many plants rooted in scarp face. Veg cover often extends beyond scarp toe.
boundary	consistent	variable	consistent

10. Erosion process intensity and evidence(Note that this will vary depending on recent weather conditions as well as the susceptibility of the site.):
- **N**one - not visible anywhere at the site
- **R**are - occasionally visible in the susceptible areas, mostly low intensity where it does occur
- **C**ommon – much of the susceptible area shows evidence of process
- **F**requent – almost all of the susceptible area shows evidence of the process, mostly high intensity
- Type of evidence: **P**rocess (eg needle ice seen) or **F**eature (eg soil crumbs visible)
- Dominated by **E**rosion, **T**ransport or **D**eposition
- Notes on location and type of feature (eg around scarps)

Features suggesting **frost heave** include soil crumbs, heaved seedlings, heaved erosion pins, heaved root systems.

Features suggesting **aeolian** transport include deposits of uniform sand to granule size sediment in dunes or in lee of obstacles

Features suggesting **sheet** flow include scoured areas focussed along micro depressions, and broad low deposits of fine sediments also along depressions

Features suggesting **channel erosion** include channels with bare bed and or bank, and in particular features such as head cuts

Features suggesting **browsing** include scats, cropped vegetation and rabbit scrapes (note these separately)

11. Recovery impressions based on observations

Code	Veg description
A	Rapid veg recovery – Very healthy plants expanding on vegetated margins. Vegetation expansion is from new plant establishment as well as expansion of existing individuals. New plants growing under shelter of old, also healthy seedlings in degraded areas that are older than 1 year. Areas of plant death very rare
B	Slow veg recovery – Vegetated area increasing, dominated by expansion of existing individuals. Individual plants may appear large, and extend over degraded areas that would once have been bare, eg prostrate plants growing over erosion scarp and across erosion pavement. New plants not common, and where they do occur are mainly under shelter of existing vegetation/litter rather than in degraded areas. Areas of plant death may be present, but are rare.
C	Stable veg – Some areas of growth, some of retreat. Approximate balance between areas loosing and gaining vegetation. Established seedlings outside main vegetated areas absent or very rare.
D	Slow veg deterioration – Vegetated area decreasing slowly. Plant health stable to poor. Areas of plant death occasional to common. Seedling establishment rare or completely absent. Probably combined with some soil erosion.
E	Rapid veg deterioration – Area of veg decreasing rapidly. Plant health generally poor. Plant death frequent. Uprooted plants may be seen. Seedling establishment rare or completely absent. Probably combined with rapid soil erosion, possibly including mass failure of soil on erosion scarps.

Code	Soil condition description
5	Rapid soil recovery – Remnant soil all completely stable. Stable soil building up in degraded areas from incorporation of new organic material and recently deposited sediment*
4	Slow soil recovery – No sign of ongoing soil loss. Some soil recovery occurring from build up of recently transported sediment. Recent deposits are partly stabilised by veg.
3	Stable soil – No sign of ongoing soil loss. Degraded areas stabilised by erosion pavement or vegetation. New soil development limited by rate of rock weathering.
2	Slow soil erosion – Erosion of degraded areas slowed by erosion pavement, but still occurring. Disturbance of soil in remnant areas occasional to common. Erosion mainly by scour and frost heave.
1	Rapid soil erosion – Signs of soil erosion continuing frequent in both degraded and remnant areas. Erosion by scour and frost heave, but mass failure may also occur on high soil scarps. Some efficient process of sediment removal is probably required, such as stream flow. Probably coincides with rapid veg deterioration.

12. Rehabilitation potential = potential for intervention to improve the trajectory of the site, ie increase rate of recovery or stop degradation. If potential is medium or high, state what intervention is needed

Code	Description
High	A small intervention can be expected with confidence to have a large impact on site condition. Recovery of site prevented by a single process that can be easily and permanently stopped by one or two interventions. Egs – stream flow that could easily be re-routed, lack of seed.
Med	Intervention may improve rate of site recovery. Confidence in intervention is only moderate. Typically more than one degrading process operating, but often at low intensity. Intervention may need to be repeated before site becomes stable.
Low	Intervention unlikely to make a large difference to condition of site. Could be because rapid natural recovery renders intervention unnecessary, or because very poor condition of site and multiple contributing degrading processes means that intervention would be complex, expensive and unlikely to succeed, particularly in long term.

8.2. Appendix 2: site survey data sheets and supporting notes

Central Plateau Erosion Reconnaissance Fieldwork 2005 – Degraded Area Assessment

Date		**Staff**		Site name		
Weather				**Patch centre or margin**		
Surface conditions 1	moisture		frost	**Dist to patch margin**		
Waypoint, gridref						
Photos						
Other datasheets						

Environment					
Elevation		Mapped erosion cat		Erosion intensity 4	
Slope		Aspect		Topo position 2	
Drainage 13		Inundation 7		Area (S,M,L) 3	
(Peri-)Glacial landform 5		Variability w/i site			
Veg type	Veg description 6				

Surface cover transect 0-1, 1-5, 5-10, 10-20, 20-30, 30-40, 40-50, ..., 90-100%											*Mean*
% projected higher veg											
% mosses and lichens											
% litter											
% bedrock/large rock											
% erosion pavement											
% bare soil											
soil depth (cm)											
innundation index 7											

Soil						
Soil type 8	peat	in-situ Jd/Tb	aeolian	alpine humus	Other	
A horizon (NRCF)	intact area		remnant		eroded area	

Net soil depth											Mean
eroded area											
remnant area											

Boundary between intact and eroded (1-3) 9		steep scarp height	

Eroded area ***(None/Rare/Common/Frequent; Feature/Process, Erosion/Deposition) 10***

*Ongoing erosion **10***	*intensity*	*evidence*	*eros/dep*	*notes*			
frost heave							
solifluction							
sheet flow							
channelised flow							
aeolian							
bare soil scarps							
browsing				rabbit poo **10**		wallaby poo **10**	

Signs of recovery (None, Rare, Common or Frequent and observations on location)

young seedlings		
seedlings>1yr old		
veg on scarps		

Remnant area ***(None/Rare/Common/Frequent; Feature/Process, Erosion/Deposition) 10***							
Ongoing erosion ***10***	*intensity*	*evidence*	*eros/dep*	*notes*			
frost heave							
solifluction							
sheet flow							
channelised flow							
aeolian							
bare soil							
browsing				rabbit poo **10**		wallaby poo **10**	
Signs of recovery (None, Rare, Common or Frequent and observations on location)							
young seedlings							
seedlings>1yr old							
large healthy plant growth							
Veg & soil trajectory 13							
Rehab potential 12							

8.3. Appendix 3: Central Plateau Sheet Erosion Monitoring Field Sheet

Date	**Staff**	Site name, code			
Quadrat number		left pin	right pin		
Waypoint, gridref		**dist and bearing to star picket**			
Description of location					
Photo no. & descript					
Weather		**Surface conditions**	moisture		frost
Quadrat Environment		**Matching fieldsheets**			

Elevation		Erosion category		Veg	
Slope		Aspect		Topo position	
Drainage		periglac landform		Erosion intensity	

Quadrat map – mark survey area in intact quadrant, survey area in eroded quadrant and position of erosion and vegetation boundary and major outliers

	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E										
F										
G										
H										
I										
J										

Erosion and veg boundary

horiz dist	erosion boundry cm	veg boundry cm
0		
20		
40		
60		
80		
100		

Soil depth (cm)

	Remnant area			Eroded area		
depth						
grid ref						

Cover

	Remnant	Eroded	
% projected live veg			
% moss			
% litter			
% dead attached veg			
% bedrock/large rock			
% erosion pavement			
% bare soil			

Soil type	peat	in-situ Jd/Tb	aeolian	alpine humus	

Signs of ongoing erosion processes Intensity (NOCF)/net erosion or deposition/notes

	Remnant		Eroded		
	Intens	E/D	Intens	E/D	
frost heave					
solifluction					
sheet flow					
channelised flow					
aeolian					
bare soil scarps					
browsing					
rabbit poo					options 0, <10, <30, >30
wallaby poo					options 0, <10, <30, >30

Nature of boundary

boundary type (1-3)						
proportion of scarp vegetated	0-20	20-40	40-60	60-80	80-100	
condition of veg on scarp (1-3)						

Notes

boundary character consistency	consistent	variable	consistent