TASMANIAN | Land | CONSERVANCY

Annual Reserve Report

Five Rivers Reserve 2014-15

www.tasland.org.au

Introduction

The Tasmanian Land Conservancy (TLC) protects important natural areas as permanent reserves and aims to demonstrate excellence in reserve management for biodiversity conservation. To achieve this aim, the TLC has adopted an adaptive management framework – the Open Standards for the Practice of Conservation. The framework comprises 6 key steps – planning, implementing, monitoring, reporting, review/adaptation and communication.

Five Rivers Reserve was acquired by the TLC in 2010 and protects over 11,000 hectares of highland forests and marshlands on Tasmania's Central Plateau. The management of the Reserve is guided by the Five Rivers Reserve Management Plan. The plan is implemented by TLC staff through an annual Reserve Work Plan and Monitoring Plan. Details of ecological monitoring methods can be found in TLC's Ecological Monitoring Procedures Manual. This report describes progress made towards delivery of the management plan in 2014-15, and is divided into three sections:

- Reserve Scorecard – a table summarising the results of management effectiveness and ecological monitoring to date;
- Management Effectiveness Summary – providing details of the implementation of key management strategies and making recommendations for plan improvement;
- Ecological Monitoring Summary – providing details of the status of conservation targets and trends of key ecological indicators. This summary presents the findings of monitoring conducted in 2014-15 – the next round of ecological monitoring is scheduled for 2015-16

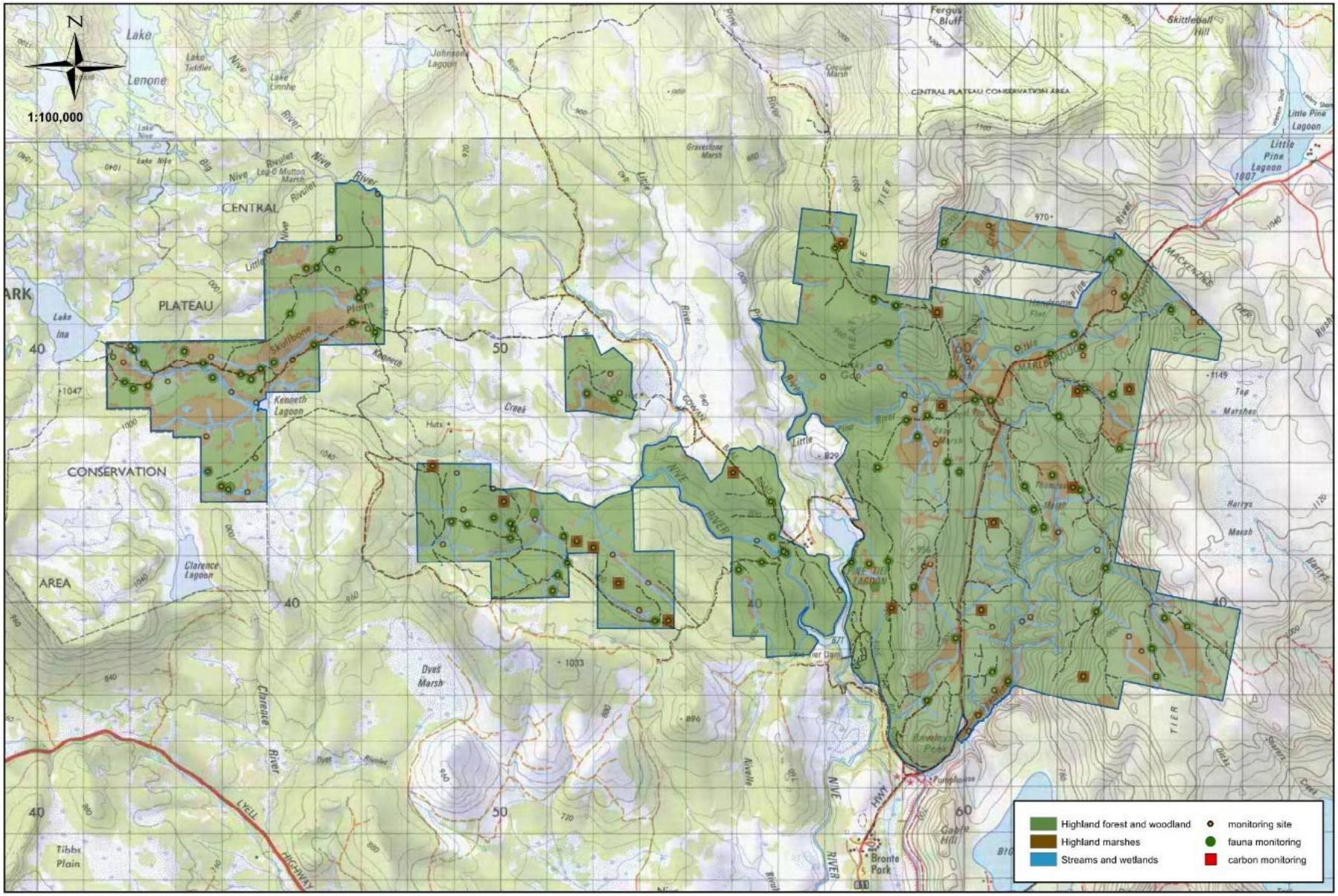
The recommendations made in this report are used to adapt and improve management of the Reserve, update the management plan, and revise work and monitoring plans for the coming year. Key findings of this report are communicated to TLC Board, supporters and other stakeholders.

Volunteer Contribution

During 2014-15 volunteers continued to make a fantastic contribution to monitoring and on-ground management across the Five Rivers Reserve. A small team of volunteers aided in the collection of floristic information for the long-term ecological monitoring program and also helped with predator scat collection and to deploy and retrieve remote cameras for carnivorous mammal monitoring. Volunteers were pivotal in collecting the second peat core extracted from the sphagnum beds on Skullbone Plains and habitat assessment for future works on the Clarence galaxias. Volunteers also contributed hundreds of hours to on-ground works programs including weed management, feral animal control and seed collection.

Organisational Collaboration

The TLC worked with a number of organisations in 2014-15 on a diverse range of conservation projects. Key partnerships included: Inland Fisheries Service (monitoring of Clarence galaxias at Skullbone Plains); DPIPWE and ANU (sphagnum peatland research); Forest Practices Authority (eagle nest activity assessment); and Royal Tasmanian Botanical Gardens Seed Conservation Centre (threatened plant seed collection).



Five Rivers Reserve - Monitoring Sites

Map produced by the Tasmanian Land Conservancy - 22/01/2014

Five Rivers Reserve Scorecard 2014-15

Target and Indicator	Status / Management Priority	Viability / Trend
Highland Marshes	**High Priority**	**Very Good**
Floristic diversity	12.5 species/site	Unknown
Structural complexity	9.1 strata/site	Unknown
Miena cider gum recruitment	> 3 age cohorts present	Unknown
Sphagnum peatland extent	100.8 hectares	Unknown
Vertebrate fauna diversity	17 species (total), 0.15 species/trap-night	Unknown
Bird diversity	17 species (total), Mean 9 species per site	Unknown
Streams and wetlands	**High Priority**	**Very Good**
Water quality via aquatic biota diversity	Data to be collected in spring 2014	Unknown
Floristic diversity	12.6 species/site	Unknown
Structural complexity	8.9 strata/site	Unknown
Vertebrate fauna diversity	0.1 species per trap night	Unknown
Bird diversity	11 species (total), 6.4 species per site	Unknown
Drooping pine population size	Present but not fully mapped	Unknown
Clarence galaxid populations	Species detected at 4 sites (IFS data)	population stable
Highland forest and woodland	**Medium**	**Very Good**
Floristic diversity	10.4 species/site	Unknown
Structural complexity	10.3 strata/site	Unknown
Canopy recruitment	2.9 cohorts per site	Unknown
Vertebrate fauna diversity	0.15 species per trap night	Unknown
Bird diversity	20 species (total), 13.5 species per site	Unknown
Wedge-tailed eagle nesting success	2 of 5 nests successful 2 fledged young	Improvement from one successful nest in 2013
Forest cover change in reserve	No data for report period	No change 2000-2010
Forest cover change - 20km	No data for report period	Significant decline 2000-2010
Carnivorous marsupials	**High**	**Good**
Spotted-tailed quoll (*Dasyurus maculatus*)		
Occupancy	Detected at 5/37 sites (14% of sites)	Unknown
Relative abundance	8 observations (2455 trap nights)	Unknown
Eastern quoll (*Dasyurus viverinus*)		
Occupancy	Detected at 18/37 sites (49% of sites)	Unknown
Relative abundance	94 observations (2455 trap nights)	Unknown
Tasmanian devil (*Sarcophilus harrisii*)		
Occupancy	Detected at 36/37 sites (97% of sites	Unknown
Relative abundance	361 observations (2455 trap nights)	Unknown
Disease status	DFTD suspected 5/36 (13% of sites)	Present
Fauna pests		
Feral cat (*Felis catus*)		
Occupancy	Detected at 23/37 (62% of sites)	Unknown
Relative abundance	52 observations (2455 trap nights)	Unknown
Fallow deer (*Dama dama*)		
Occupancy	Detected at 12/37 (32% of sites)	Unknown
Relative abundance	47 observations (2455 trap nights)	Unknown
European rabbit (*Oryctolagus cuniculus)*		
Occupancy	Detected at 8/37 (22% of sites)	Unknown
Relative abundance	20 observations (2455 trap nights)	Unknown
Community connection with landscape	**Medium**	**Good**
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
# people engaged in scientific activities	25 (Bushblitz, Sphagnum)	Increase
# people engaged in education activities	16 TAFE staff and students	Increase
# people engaged in recreational activities	60 (Riverfly, hunting, general visits)	Slight decrease
# volunteer days on the reserve	357 days in 2013-14	Increase
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
Cultural heritage	**Medium**	**Not determined**
Intactness of indigeneous heritage sites	Not documented	Unknown
Understanding and interpretation of indigenous knowledge	Not documented	Unknown
Intactness of cultural heritage sites	State of decay	Unknown
Preservation of cultural history sites	Being documented	Unknown
Regional capacity	**Medium**	**Poor**
Not yet defined	No data	unknown

Management Effectiveness Summary

Access Management

What we are doing?

The aim of this strategy is to regulate access to the Reserve and to prevent illegal access. Illegal access has been a significant problem at the Five Rivers Reserve historically. Serious environmental impacts are associated with illegal access, and significant human and financial resources have been applied to dealing with this major threat to the natural values of the Reserve.

And why?

In the past, unregulated access has caused significant impacts to TLC Reserves. Unauthorised access continues to be an issue at some Reserves. Unauthorised access is associated with a range of activities that impact on the natural values of a Reserve, including hunting, wood-hooking, campfires, dumping of rubbish, and damage to infrastructure such as gates and fences, and off-road vehicle use. A variety of mechanisms are used to regulate access including infrastructure such as fences and gates, information provided in signs, and direct communication with the local community and potential visitors.

Key objective(s)

Unauthorised access is reduced by 80% by 2020

Outcome 2015

In 2015 there were <10 known incidences of illegal access on the Reserve. This number has reduced by approximately 50% since 2014.

Construction of a vehicle barrier at Skullbone Plains

Progress in 2014-15

- There has been ongoing road maintenance, predominantly drainage management of roads that were identified as needing to stay open. Roadside spraying has kept the roads open of vegetation. A serious washout has been repaired, by digging out the culvert and using it to resurface the roads. Clearing tree falls as necessary.
- TLC has installed cameras and has detected a few instances of illegal access. We've talked with some of the locals involved. A monitoring camera was stolen in March. Generally illegal access is down from last year.
- A gate was broken in the southeast part of Serpentine and was repaired. Some additional trenches have been installed on the Marlborough highway.

Key recommendations for future management

- Continue the successful program of road, gate and trench maintenance
- A fence along the Marlborough Road near the old hut site needs to be repaired

Clarence Galaxias Management

What we are doing?

The aim of this strategy is to prevent the establishment of Brown Trout in areas where Clarence galaxias occurs. A secondary aim is to work with partners to investigate the potential to eradicate trout from other small water bodies to expand area of occupancy of Clarence galaxias as specified in the species recovery plan.

And why?

Brown trout have the potential to cause extinction of native fish species. Anglers are the most likely vector for introduction. Access control and the encouragement of responsible fishing practices are some of the ways that the risk can be reduced.

Key objective(s)

No introductions of brown trout into Clarence galaxias habitat

Outcomes

No Brown Trout were detected in waterways where Clarence galaxias occurs

Peter Davies and Laurie Cook surveying for Clarence galaxias at Cider Gum Tarn: pic TLC

Progress in 2014-15

- Site sampling of Cider Gum Tarn and Kenneth Lagoon undertaken by consultants
- Site inspection for potential fish barrier placement by Inland Fisheries staff
- Preliminary acoustic monitoring of fish and collaboration with Leah Barclay
- Project plan underway to increase the area of occupancy of Clarence galaxias

Key recommendations for future management

- Continue to work with IFS and other stakeholders on monitoring and other conservation works to protect the Clarence galaxias.

Community Engagement

What we are doing?

The aim of this strategy is to engage with the Central Highlands community and with the wider Tasmanian community. At Five Rivers Reserve there are a variety of activities that encourage community engagement, including open days, public consultation, working with stakeholders and neighbours, educational visits, and providing opportunities for volunteering.

And why?

The TLC provides opportunities for the community and individuals to achieve conservation. The local community, volunteers, the indigenous community and other stakeholders are encouraged to participate in planning and land management activities. TLC Reserves provide excellent opportunities for education and scientific research. Sustainable economic development may be supported at some reserves where appropriate.

Key objective(s)

The Tasmanian community are accessing the property for projects and/or are engaged with TLC in management of the Reserve

Outcomes

TLC has supported a range of recreational, educational and volunteering activities on the Reserve

Volunteer Elise Dewar helps with carnivorous marsupial monitoring : pic TLC

Progress in 2014-15

- Two outdoor education teachers course were hosted on the Reserve
- In February 2015 TLC delivered a five day intensive course at Bronte Park on Open Standards reserve management to 13 graduate students using Five Rivers Reserve as the field study
- TLC hosted two field trips for supporters
- 16 volunteers participated in monitoring and weed control works, contributing a total of 32 days or 228 hours of their time
- TLC has provided ongoing support for self-guided visits

Key recommendations for future management

- Continue to work with a diverse range of stakeholders to create opportunities for community access and engagement with Five Rivers Reserve
- Continue to identify opportunities for volunteers to assist with reserve management and monitoring activities and ensure this information is included in the volunteer policy

Feral Animal Control

What we are doing?

The aim of this strategy is to minimise the impact of feral species on the natural values of the Reserve. Targeted monitoring using remote cameras and other methods will identify a baseline measure of population that will be used to measure the effectiveness of control measures. A Feral Animal Management Plan will be prepared to reduce populations of both predators such as cats and European wasps, and herbivores such as deer and rabbits. This may require the development of DPIPWE property based Game Management Plans.

And why?

Eradication of a feral animal species is usually impossible to achieve. However, variety of control methods can effectively reduce populations and consequent impacts to an acceptable level. Methods available including shooting, trapping, baiting and fencing. As animals are often widespread and mobile, it is always beneficial to work with neighbours to tackle populations at a regional level.

Key objective(s)

By 2016 distributions of key feral species have been mapped and management strategies identified.

Outcomes

Deer control has continued in partnership with the Bronte Deer Stalkers – a local community group

Baseline levels for deer, rabbit and feral cats established

A feral cat caught on TLC's monitoring camera

Pest Species	Baseline status established in 2014-15	
Fallow deer *Dama dama*	Detected at 12/37 (32% of sites), 47 observations (2455 trap nights)	
European Rabbit *Oryctolagus cuniculus*	Detected at 8/37 (22% of sites), 20 observations (2455 trap nights)	
Feral cat *Felis cattus*	Detected at 23/37 (62% of sites), 52 observations (2455 trap nights)	

Progress in 2014-15

- Baseline levels for three feral pest mammals has been established
- The Bronte Deer stalkers have provided an annual report on the number of deer sighted and the number of deer shot. TLC issued the Bronte Deer Stalkers with 3 additional deer culling tags to increase the number of deer shot. Nine deer were shot in total.
- TLC is collaborating on a deer management research project with the UTAS and Bush Heritage Australia, which will inform feral animal management at Five Rivers Reserve

Key recommendations for future management

- Obtain additional deer tags for Viormy and Skullbone Plains for 2015-16 to increase the intensity of shooting effort because impact on numbers has been insignificant.
- Form a group of TLC hunters who are willing to cull deer, including females, to substantially reduce numbers.
- Prepare of a map of deer hotspots and target control activities in these areas
- Continue monitoring of pest species to help inform management

Fire management

What we are doing?

The aim of this strategy is to reduce the impact of unplanned fire, on the people and natural environment of the Five Rivers region. Bronte Park is the largest community in the region and wildfire poses a significant risk to the community. While most of the natural values of the Reserve are relatively resilient to the impacts of fire, there are some significant features, such as sphagnum peatlands and populations of drooping pine *Pherosphaera hookeriana* that should be protected from fire wherever possible.

And why?

While fire can be a natural process, the TLC recognises the threat posed by unplanned fires to human life, property and the environment. The two primary objectives of fire management on TLC land are to protect human life and property from fire and to maintain or enhance the natural diversity of species and communities through appropriate fire regimes, in so far as this is consistent with the first objective. We work closely with relevant experts, including the Tasmanian Fire Service, fire ecologists, botanists and zoologists, to determine the fire regime prescriptions for hazard reduction and ecological maintenance.

Key objective(s)

No unauthorised fires start on the reserve by 2020

All reasonable measures are taken to prevent the spread of any fires originating on the Reserve (ongoing)

Outcomes

There were no fires on the Reserve in 2014-15

TLC Staff member Tim Devereux at the Pine Tier fire front

Progress in 2014-15

- A fire risk assessment was finalised that covers all TLC Reserves
- TLC reserve managers continue to be involved in local volunteer fire brigades

Key recommendations for future management

- Continue to implement TLC's fire policy and procedures
- Continue to maintain key roads and infrastructure such as dams
- An ecological burn plan needs to be developed for marshes and grassy woodlands
- Clear out fire-fighting reservoirs

Neighbour relations

What we are doing?

The aim of this strategy is to ensure that threats from neighbouring lands don't impact on the values of the Reserve, and vice versa. Regional management issues in the vicinity of the Five Rivers Reserve include weeds, deer, fire, livestock, illegal hunting, trespass and wood-hooking. Other management issues include road maintenance and mutual access arrangements with neighbouring landowners.

And why?

The TLC recognises the importance of maintaining good relationships with neighbouring landowners and regularly communicates with neighbours about shared management issues. Regular communication between TLC Reserve Managers and neighbouring landowners facilitates cooperative approaches to regional land management issues such as feral animals, weeds and fire management. Neighbours are informed about any TLC management strategies or issues that have the potential to impact on their land. Similarly, TLC talks to neighbours about activities or management issues on adjoining land that have the potential to impact on the values of TLC Reserves.

Key objective(s)

Regular communications are maintained with all neighbours

Outcomes

TLC staff continue to have positive relations and are working with neighbours on road maintenance, firefighting, weed control and access management

TLC Staff with managers of Gowan Brae discuss land management

Progress in 2014-15

- TLC has maintained good relationships with all of the managers of neighbouring properties and we actively cooperate with neighbours on management issues such as fire management and road, fence and gate maintenance.
- Increased cooperation with TAC on neighbouring trawtha mukaminya property

Key recommendations for future management

- Continue to cooperate with neighbours on management issues
- Continue to foster good relations with the Aboriginal community

Protecting Cultural Heritage

What are we doing?

Sites of indigenous cultural significance, and sites and structures from early European settlement are widespread on the Five Rivers Reserve. Features of cultural significance include Aboriginal stone tool scatters, the remnants of trapper's and shepherd's huts, and the remains of old fences. Landscape surveys by cultural heritage officers will increase our knowledge of cultural heritage values on the Reserve.

And why?

Cultural heritage values are recognised by TLC as an important feature of the landscapes we manage. It is important to document cultural heritage sites so that they can be better understood and managed. TLC management objectives are consistent with the Burra Charter.

Key objective(s)

By 2016, cultural heritage sites and knowledge are documented

Outcomes

A map has been produced that documents the location of known cultural heritage sites.

Ruins of a shepherd's hut on the historic Viormy property

Progress in 2014-15

- TLC Staff have a good working relationship with the Aboriginal Land Council of Tasmania and the Tasmanian Aboriginal Centre.
- TLC Staff member Bruce Hay has finished documenting his knowledge of the European history and heritage sites of the Reserve.

Key recommendations for future management

- Progress with heritage assessments of European and Aboriginal cultural heritage sites by the end of 2015
- Prepare a map of heritage sites that document Bruce's knowledge

Stock exclusion

What are we doing?

The aim of this strategy is to prevent neighbouring livestock from accessing and grazing the Reserve. Sheep and cattle are grazed on the neighbouring property Pine Tier. There are occasional incidences of stock breaching fences and straying onto the Five Rivers Reserve. Ongoing fence maintenance and talks with the neighbouring landholder keep this threat at a low level.

And why?

Livestock have the potential to impact on sensitive vegetation types. Where this is a direct threat the TLC will take actions to prevent stock from accessing a Reserve. This will usually involve construction and maintenance of boundary fences in cooperation with neighbouring land owners.

Key objective(s)

Impact of neighbouring stock is maintained at a low level

Outcomes

Several incursions by livestock have been detected on Reserve. The impact of livestock on the Reserve continues to be negligible.

Boundary fencing - upgraded in 2014

Progress in 2014-15

- Fences have been maintained as required
- A new gate has been installed on the 'Viormy Island Block' to reduce stock access. However, stock are accessing the reserve from the southern boundary and northern boundary, which has poor quality fencing.

Key recommendations for future management

- Inspect and repair fences in the vicinity of Pine Tier Lagoon and around Howards Way gate/cattle grid, because cows have been accessing the property occasionally
- Inspect the fences and upgrade the gate on the northern and southern boundary of the Viormy Island Block

Visitor management

What are we doing?

The aim of this strategy is to ensure that reserve visitation is undertaken in a safe and sustainable manner. TLC aims to produce an information brochure that can be provided to all visitors to the Reserve, which includes information about natural values, management issues, threats and a map. Until this has been prepared all visitors to the Reserve are required to sign a waiver and access agreement, and TLC staff will provide a map and personal briefing.

And why?

The TLC encourages visitation at its Reserves and recognises the importance of natural places to human wellbeing. TLC Reserves provide the community with fantastic opportunities for recreation and enjoyment of beautiful and unique natural environments. Regulation of reserve visitation ensures that the natural values of a Reserve are protected. Recreational activities such as bushwalking, camping, bird-watching, cycling and trout fishing, are generally compatible with conservation. Infrastructure such as tracks and camping platforms are provided at some Reserves to minimise visitor impacts. Some activities that pose a threat to the natural values of Reserves are controlled or prohibited, such as four-wheel driving, hunting and lighting campfires. All visitors to TLC Reserves are asked to take measures to ensure that weeds and pathogens such as phytophthora are not introduced to a Reserve.

Key objective(s)

People visit the Reserve every year

Visitors comply with TLC policies

Outcomes

A large number of people continue to visit the Five Rivers Reserve, with World Heritage listed Skullbone Plains a major drawcard.

A group of bushwalkers on their way to Lake Ina

Progress in 2014-15

- A draft visitor guide has been prepared by TLC volunteer Marie Brolev
- TLC is in discussions with the Tasmanian Aboriginal Centre about developing a guided work that traverses trawtha mukaminya and Skullbone Plains
- Riverfly Tasmania continues to take people to the Reserve to access trout fishing areas in the WHA

Key recommendations for future management

- Finalise the reserve visitor guide
- Continue to work with TAC on developing a guided walk

Weed management

What are we doing?

The aim of this strategy is to eradicate existing infestations of weeds on the Five Rivers Reserve. Ragwort and California thistle occur along roads and at logging landings. Weed mapping and control is continuing. Although weed infestations are not extensive, their eradication should be undertaken in a timely and effective manner before they increase in range. A weed action plan has been prepared for the reserve to ensure the weed works already underway on the reserve are built into works programs and undertaken effectively over the coming a five year period.

And why?

Weeds monitoring and control occurs on all TLC Reserves. The impact of different weed species varies with environmental conditions. It is therefore important to prioritise species and areas for control. Weed control is usually a long term commitment as soil-stored seed may continue to germinate for decades. Monitoring and follow-up control are therefore essential to successful weed eradication. When tackling weeds it is always beneficial to work with neighbours on what is often a regional issue.

Key objective(s)

Existing infestations of weeds are functionally eradicated from the Reserve by 2017

Outcomes

Overall decrease in quantity of weeds found, using herbicide volume as a proxy

TLC's Denna Kingdom and a volunteer doing ragwort control

Progress in 2014-15

- The Central Highlands weed management plan has been completed and is now being implemented. This plan encompasses several TLC properties including the Five Rivers Reserve.
- TLC staff and volunteers have completed a fifth round of weed treatment across the Five Rivers Reserve. Work was supported by an Australian Government Community Action Grant.

Key recommendations for future management

- Consolidate the GIS components of the weed management program
- Continue with weed control

Ecosystem Services

What are we doing?
TLC is exploring a number of avenues for generating revenue from the Five Rivers Reserve to assist with conservation management and provide benefits to the wider community. The TLC has implemented a carbon project over logged forest on the Five Rivers Reserve and successfully sold the first two years of credits. A three year licence to Riverfly Tasmania (http://riverfly.com.au/) has been granted to establish huts and operate their World Heritage Area tours. Other potential developments such as TasTrail, firewood harvesting, camping, nature photographers etc are being implemented and investigated.

And why?
Financial stability and security is critical in ensuring management of special conservation areas can be maintained in perpetuity. A range of brand-aligned products and programs that generate revenue can help underpin the costs of conservation management of protected areas without compromising natural values. They can also enable wider community benefits and services to be provided which strengthen the community's connection with the land.

Key objective(s)

Ecosystem service derived income supplements reserve costs by 10% annually

Outcomes

Revenue generated from sale of carbon credits, events, leases and licences is contributing 10% of reserve costs.

Demountable Riverfly huts for accessing trout fishing on Lake Ina

Progress in 2014-15

- The second years carbon vintage (2012) has been sold and generating gross income to the Five Rivers Reserve conservation programs.
- Deer hunters current receipts are $4,320 for FY 14
- Revenue has been received from Riverfly huts licence and gravel licence.

Key recommendations for future management

- Continue to develop and secure ecosystem service programs that support conservation of the reserve and provide wider community benefits

Conservation Research

What we are doing?
The TLC is actively improving knowledge on a range of threatened species which are either poorly known or for which additional information will assist their management on the reserve. Extension surveys and habitat assessments are planned for a range of plant and invertebrate species in 2014 / 2015 and seed collection by the Tasmanian Seed Conservation Centre (RTBG) has begun.

And why?
The Five Rivers Reserve contains five listed vegetation communities, 17 listed flora and 10 known or suspected threatened fauna. Some of these species / communities are either poorly known or more information is required to improve their conservation management. Improved information will increase the potential for these threatened elements to survive in the wild long-term and further enhance the conservation significance of the Five Rivers Reserve in the Tasmanian landscape.

Key objective(s)

Improve knowledge of the Reserves natural values

Outcomes

The TLC continues to attract national and international research interest

Dr Jennie Whinam and Geoff Hope collecting a 2nd peat core

Progress in 2014-15

- Dr Jennie Whinam and scientists from the University of Canberra collected a second sphagnum peat cores for further analysis of climate change and fires history.
- Seed was collected from alpine conifers for the Millenium seed bank by TLC staff and Dr J. Wood RTBG

Key recommendations for future management

- Undertake Miena jewel beetle and Ptunarra brown butterfly habitat assessment in 2015
- Assess potential for restoration of degraded Sphagnum bog at Roscarborough

Ecological Monitoring Summary

Between December 2013 and January 2014 the TLC rolled out its long-term ecological monitoring program across the Five Rivers Reserve. A total of 161 monitoring sites were established to gather long-term information on the flora, fauna and ecological processes of the reserve. The first tranche of baseline data was collected from February to April 2014 and provides reference condition for ecological monitoring in future years. As 2014 is the first year of ecological monitoring on the Five Rivers Reserve it is not possible to determine trends in target health for ecological indicators such as floristic diversity, structural complexity and canopy cover etc.

The methods used to undertake each of these monitoring techniques have been described in detail in TLC's Ecological Monitoring Procedures Manual. Appendix A contains a summary of the list of monitoring techniques used to measure the health and condition of the conservation and social targets on the Five Rivers Reserve. In brief:

- 100 long term photo-monitoring points installed across the reserve are used to measure vegetation condition (indices of structural complexity, floristic diversity and recruitment of canopy species), and flora species lists were compiled at each site by line intercept transect.
- Satellite imagery is used to measure spatial extent and arrangement of vegetation communities.
- Fauna diversity is measured at a subset of photo-monitoring sites using motion sensor cameras (unbaited). Motion sensor cameras set along roads and tracks are also used to measure carnivorous mammal occupancy and relative abundance diversity. Bird diversity is recorded using BirdLife Australia's 2ha bird counts at a subset of monitoring sites.
- Nested targets such as Miena cider gum, Clarence galaxias, wedge-tailed eagle productivity, etc. are determined from species specific field surveys.

Highland Marshes

Collection of baseline monitoring data in 2013-14 yielded important information about the ecology and condition of highland marshes at Five Rivers Reserve. The floristic diversity of the marshes is significantly higher than that of forested areas. This diversity can be observed in the complex mosaic of vegetation types that have formed in response to local variation in fire history, soil fertility, altitude and drainage. Overall the vegetation is in excellent condition, with little evidence of impacts from human activities, weeds or feral animals.

Goals

- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain recruitment of Miena cider gum
- Maintain sphagnum peatland extent
- Maintain or improve vertebrate fauna diversity

Diverse flora occurs in highland marshes

Ecological indicator	Current status	Trend
Floristic diversity	12.5 species/site	Unknown
Structural complexity	9.1 strata/site	Unknown
Miena cider gum recruitment	> 3 age cohorts present	Unknown
Sphagnum peatland extent	100.8 hectares	Unknown
Vertebrate fauna diversity	17 species (total) 0.15 species/trap-night	Unknown

Key findings

- A population of Miena Cider Gum on Mackenzie's Tier was assessed in 2013 and found to be in good condition compared to other populations on the Central Plateau. The population contained large mature trees, saplings and many seedlings (> 3 cohorts), which indicates it has been reproducing successfully over a long time period.
- Sphagnum peatland is a threatened ecological community that is especially sensitive to the impacts of fire and climate change. This community was systematically mapped in 2013 and will be a focus of ongoing monitoring.
- 17 species of vertebrate fauna were observed using remote cameras, including two threatened species (spotted-tailed quoll, Tasmanian devil) and two priority species (eastern quoll, bettong). Deer, rabbits and cats were also observed. Deer and rabbits are in low numbers, but the presence of feral cats poses an ongoing threat to critical weight range mammals.

Recommendations

- Develop and implement a cat management program with an emphasis on Highland Marshes, which are a focus for critical weight range animals including threatened and priority species.
- Continue to monitor the impact of deer and rabbits.

Streams and wetlands

The freshwater ecosystems of the Five Rivers Reserve are of outstanding conservation value. They comprise the near-pristine catchments of five headwater tributaries of the Derwent River. Monitoring of the riparian zone commenced in 2013-14 and monitoring of aquatic biota and water quality will commence in spring 2014. The riparian vegetation is in excellent condition and is weed-free. Assessment of populations of the threatened Clarence galaxias and drooping pine, show that these species continue to persist at Skullbone Plains.

Goals

- Maintain the diversity of aquatic biota
- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain or improve vertebrate fauna diversity
- Maintain populations of drooping pine
- Maintain populations of Clarence galaxias

Wetlands provide habitat for Clarence galaxias

Ecological indicator	Current status	Trend
Aquatic biota diversity	Data to be collected in spring 2014	Unknown
Floristic diversity	12.6 species/site	Unknown
Structural complexity	8.9 strata/site	Unknown
Vertebrate fauna diversity	0.1 species per trap night	Unknown
Bird diversity	11 species (total) 6.4 species per site	Unknown
Drooping pine population size	Present but not fully mapped	Unknown
Clarence galaxid populations	Species detected at 4 sites, no trout detected (IFS data)	Population stable

Key findings

- Riparian vegetation is in excellent condition. It is floristically diverse, structurally complex and weed-free
- A report being prepared by Dr Jean Jackson will provide conservation advice for the Clarence galaxias
- Long-term monitoring of dwarf conifers established to detect potential impact from climate change

Recommendations

- Conduct extension surveys for drooping pine in riparian vegetation along the Nive River on the Viormy section of the Reserve.
- Support completion and implementation of the galaxias report
- Train TLC staff in monitoring methods for Clarence galaxias to support and expand the monitoring efforts of IFS
- Train TLC staff in the TRCI methodology so that TLC can monitor aquatic biota, which is currently being undertaken by Dr Peter Davies from the University of Tasmania.

Highland Forest and Woodland

The highland forests and woodlands of Five Rivers Reserve are in good condition, despite extensive logging having occurred in the past 20 years. Construction of infrastructure such as roads, snig tracks and logging landings has caused significant localised degradation. Weeds are limited to these degraded areas. A detailed comparison of logged and unlogged areas using monitoring data collected in 2013-14 found only minor effects of logging on the natural values of the Reserve. The long term impact of timber harvesting has been low in productive environments, where vigorous recruitment can be observed, but the impact likely to be much longer lasting in unproductive alpine areas, where the harsh environment inhibits regeneration.

Goals

- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain or improve recruitment of canopy species
- Maintain or improve vertebrate fauna diversity
- Maintain or improve reproductive success of wedge-tailed eagle
- Maintain forest cover within 2% of 2010 baseline

Highland forest typical on the Five Rivers Reserve

Ecological indicator	Current status	Trend
Floristic diversity	10.4 species/site	Unknown
Structural complexity	10.3 strata/site	Unknown
Canopy recruitment	2.9 cohorts per site	Unknown
Vertebrate fauna diversity	0.15 species per trap night	Unknown
Bird diversity	20 species (total) 13.5 species per site	Unknown
Wedge-tailed eagle nesting success	2 of 5 nests successful 2 fledged young	Improvement from one successful nest in 2013
Forest cover change in reserve	No data for report period	No change 2000-2010
Forest cover change - 20km	No data for report period	Significant decline 2000-2010

Key findings

- minimal logging impacts on flora and fauna, especially in productive environments
- Vigorous recruitment in productive lowland areas, less advanced in sub-alpine areas.
- There are five wedge-tailed eagle nests on the Five River Reserve, including a nest that was discovered in 2013. Nest 245 (raptor nest database) was reoccupied in 2013. Two young
- A loss in forest cover of approximately 1ha was investigated and determined to be an error in the GIS analytical technique.

Recommendations

- Establish additional flora and fauna monitoring sites within the Pine Tier bushfire area In 2015 to investigate the impact of a low intensity burn on conservation values
- Maintain monitoring as planned

Carnivorous Marsupials

Collection of baseline monitoring data from motion sensor cameras in 2013-14 yielded important information about the relative abundance and extent of Tasmania's three largest carnivorous marsupials. The viability rating of 'very good' refers to the presence of the three dasyurid species on the reserve and their co-occurrence at many of the monitoring sites. The continued persistence of the Tasmanian devil facial tumour disease DFTD prevented a viability score of 'Excellent' despite the species persisting in relatively good numbers. Spotted-tail quoll detection rate was relatively low.

Goals

- Maintain wild, free ranging populations of carnivorous marsupials

Tasmanian devil with DFTD

Ecological indicator	Status in 2014-15	Trend
Spotted-tailed quoll (*Dasyurus maculatus*)		
Occupancy	Detected at 5/37 sites (14% of sites)	Unknown
Relative abundance	8 observations (2455 trap nights)	Unknown
Eastern quoll (*Dasyurus viverinus*)		
Occupancy	Detected at 18/37 sites (49% of sites)	Unknown
Relative abundance	94 observations (2455 trap nights)	Unknown
Tasmanian devil (*Sarcophilus harrisii*)		
Occupancy	Detected at 36/37 sites (97% of sites)	Unknown
Relative abundance	361 observations (2455 trap nights)	Unknown
Disease status	DFTD suspected 5/36 (13% of sites)	Present

Key findings

- 24 species of fauna were identified including four carnivorous species detected
- The Tasmanian devil was the most commonly observed carnivorous species
- Devil facial tumour disease was suspected in devils at 5 / 36 devil sites FIRI 101, 104, 120, 134, 136 equalling 13.8% of sites on the Reserve
- Eastern quoll and spotted-tailed quoll are relatively rare species at Five Rivers

Recommendations

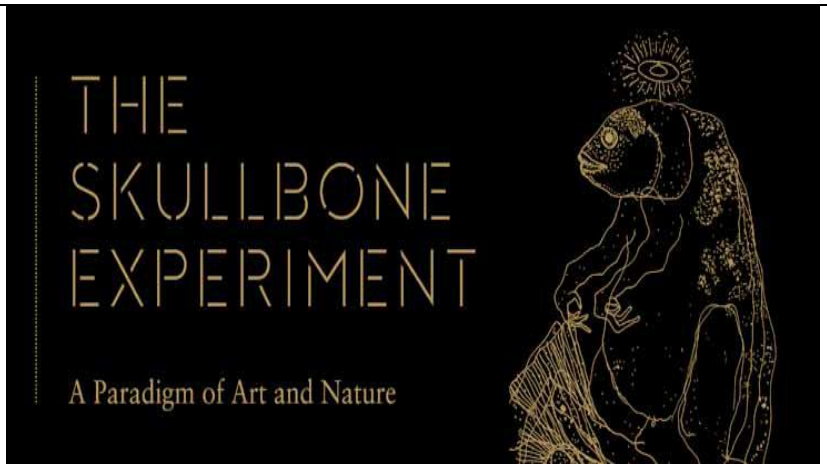
- Continue carnivore monitoring on an annual basis and standardise camera placement, settings and duration of trap nights
- Investigate other options to improve detectability of spotted-tail quoll
- Gather more information on feral cat ecology and develop a feral cat management strategy

Community connection with the landscape - Viability: Good

There is a high degree of public interest in the Five Rivers Reserve, and the TLC continues to encourage community connection with the landscape. While there is still some degree of suspicion and hostility from parts of the local community, overwhelmingly the response to the acquisition and management of the Five Rivers Reserve has been positive. People visit the reserve for a variety of cultural, artistic, recreational and educational reasons. TLCs Artists Retreat leading to the 'Skullbone Experiment' has resulted in national and international acclaim profiling the connection between art and nature. There are a significant number of people who actively participate in the management of the reserve as volunteers in management planning, weeding, and ecological monitoring as well as deer shooting, which contributes to TLCs control feral species. TLC staff support local businesses through purchase of food, fuel and accommodation and hire of local contractors.

Goals

- Foster opportunities for the community to connect with the reserve
- Harness knowledge of the Bronte landscape to enhance management and support healthy communities



'The Skullbone Experiment' major art exhibition

Indicator	Current status	Trend
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
# people engaged in scientific activities	25 (Bushblitz, Sphagnum)	Increase
# people engaged in education activities	16 TAFE staff and students	Increase
# people engaged in recreational activities	60 (Riverfly, hunting, general visits)	Slight decrease due to eagle gate closure in breeding season
# volunteer days on the reserve	357 days in 2013-14	Increase
Income ecosystem services	$151,877	Increase

Key findings

- Selling ecosystems services, particularly carbon credits, proved lucrative
- The Skullbone Experiment continues to be a huge success in attracting support for TLC
- Bush Blitz 2014 harnessed a significant amount of volunteer effort towards improving scientific knowledge on the reserve
- 10 BHP volunteers have been engaged in on-site management and research activities

Recommendations

- Continue to explore ecosystem service monetization
- Continue to encourage visitation to the Reserve by people in diverse and exciting ways
- Improve opportunities for locals to engage in low-impact recreational uses such as fishing and camping and trail walking.

Cultural heritage - Viability: To be determined

The Five Rivers Reserve in the wider central highland landscape contains a number of important cultural sites for Aboriginal people and also areas where there remains evidence of early European settlement, such as fences, chimneys and ruins. Although a detailed Aboriginal cultural survey has yet to be undertaken, many artefact scatters and traditional campsites are known to occur across the reserve. The remoteness of most sites means that they remain in a relatively undisturbed condition. A range of shepherd huts, boundary fences, cairns and oral histories of the early pioneering days are in various stages of being documented.

Goals

- Protect, enhance and rediscover the cultural heritage values of the reserve

Remains of a shepherd's hut on Roscarborough

Indicator	**Current status**	**Trend**
Intactness of indigeneous heritage sites	Not documented	Unknown
Understanding and interpretation of indigenous knowledge	Not documented	Unknown
Intactness of cultural heritage sites	State of decay	Unknown
Preservation of cultural history sites and knowledge	Being documented	Unknown

Key findings

- There are a large number of European cultural heritage sites scattered across the Reserve. TLC staff member Bruce Hay has an excellent knowledge of these sites and is now systematically documenting and mapping this information.
- The acquisition of the neighbouring property 'Gowan Brae' by the Tasmanian Aboriginal community has created the opportunity for documentation and collaborative management of indigenous heritage sites

Recommendations

- Commission an Aboriginal cultural survey of the reserve
- Continue to systematically map and document European heritage sites
- Support the collection of an oral history of the reserve especially in relation to past use and changes of the landscape

Regional capacity

Through our conservation activities TLC strives to provide economic benefits to the local community. A robust Central Highlands community will enhance the TLCs long term vision to support healthy communities to underpin healthy landscapes. An ecosystem services framework has been used by TLC as a way to structure thinking around income generation from reserves. By annually recording expenditure by TLC and related on-reserve activities and revenue generated in the local area, we can identify our financial contribution from conservation activities to the local community.

Goals

Reserve derived income supplements reserve costs by 5% annually

Reserve expenditure contributes to the Freycinet community

Outcome 2015

TLC activities generated local economic activity in the Freycinet region

All of these nice people stayed overnight at the Bronte Hotel

Indicator	Status 2015	Trend
Not yet defined	No data	Unknown

Key findings

- TLC activities such as monitoring, Bushblitz, the PALRC course, supporter trips and reserve management trips generated a significant economic activity in the Central Highlands community. We don't yet have methods or indicators for measuring this input.

Key recommendations for future management

- Develop a framework for accounting for the contribution of TLC activities to local communities.

Appendix A: Monitoring methods and indicators

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
Highland Marshes	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max
		Structural complexity	Mean number of strata per site	Maintain structural complexity			
		Miena Cider Gum Recruitment	Mean number of cohorts per site	Maintain recruitment			
	Sphagnum peatland spatial extent	Area	Total area of sphagnum ecosystem	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	1 site / 5ha.
	Vertebrate fauna	Mammal diversity	Total number of mammal species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
			Mean number of mammal species per trap night	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
		Bird diversity	Total number of bird species per site	Maintain bird diversity	2ha 20min count (Birdlife Australia)	2 years	2 sites per target
			Mean number of bird species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
Streams and Wetlands	Water quality	Macroinvertebrate abundance vs reference site	Mean macroinvertebrate abundance per site	Maintain water quality	Macroinvertebrate survey (TRCI)	2 years	10 sites
	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max
		Structural complexity	Mean number of strata per site	Maintain structural complexity			
		Recruitment of canopy species	Percentage of sites where recruitment of canopy species is present	Maintain recruitment			
	Clarence galaxias presence	galaxias, brown trout	Inland Fisheries Service	Maintain or expand area of occupancy	IFS electrofishing	Annually	Skullbone Plains
Highland Forest and Woodland	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
		Structural complexity	Mean number of strata per site	Improve structural complexity in logged areas,			
			Mean number of plant classes per site	Maintain structural complexity of undisturbed areas			
		Recruitment of canopy species	Number of cohorts per site	Maintain recruitment			
	Vertebrate fauna	Mammal diversity	Total number of mammal species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
			Mean number of mammal species per trap night	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
		Bird diversity	Mean number of bird species per site	Maintain bird diversity	2ha 20min count (Birdlife Australia)	2 years	2 sites per target
	Wedge-tailed eagle Reproductive Success	Nest activity	Nest maintenance, presence of eggs/chick(s)/juvenile(s)	Maintain nest activity	Nest activity survey	Twice yearly	All eagle nests
	Forest cover change in reserve	Area	Total area having forest cover	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	entire area
	Forest cover change in 20km buffer of reserve	Area	Total area having forest cover	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	entire area
Carnivorous Marsupials	Presence, density and population trends of carnivorous marsupials - Spotted tailed quoll, Eastern quoll and Tasmanian Devil	Site occupancy	Proportion of sites occupied	Maintain wild populations of carnivorous marsupials	Motion sensor cameras	Annually or biennially	Roads, tracks entire project area
		Relative abundance	(TBD)	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
		population trends	(TBD)	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
	Tasmanian devil disease status	Percentage of devil sites with DFTD		Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
	Presence, density and population trends of introduced carnivore Cat		No of individuals, cohorts, persistence in the landscape, distribution	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
Community Connection with Landscape	Community involvement	Number of people engaged in activities: cultural, scientific, educational, recreational		Increase TLC support through community involvement	Engagement opportunities	Annually	Entire project area
	Volunteer activity	Volunteer days		Increase TLC support through community involvement	Engagement opportunities	Annually	Entire project area
	Money generated from ecosystem services	Income	Income attributed directly to sale of ecosystem services form the reserve	Increase TLC support through community involvement	Accounting	Annually	Entire project area
Cultural Heritage values	Site condition	Condition of buildings	Structural integrity of buildings and presence of historical objects	Maintain building condition	Site inspection	2 years	All heritage sites
		Condition of site in surrounding landscape	Intactness / aesthetics / disturbance within viewshed of site	Maintain landscape condition	Photopoint monitoring	2 years	Site specific