Mersey-Forth Water Management Review

TECHNICAL AND SOCIAL STUDY 2013

Land Rehabilitation at Lake Mackenzie

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Executive Summary

A review of Hydro Tasmania's land and water management activities in the Mersey-Forth catchments identified the need to rehabilitate land disturbed during construction of Mackenzie dam and other infrastructure in the vicinity of Lake Mackenzie in the early 1970's.

Some areas of land have remained bare since the vegetation was removed and the ground disturbed during the construction of the dam, canals, pipelines and road infrastructure. This bare land is visible from publicly accessible areas and is subject to ongoing sheet and rill erosion by the action of wind, rain and ice.

The aim of the study was to determine the feasibility and scope of work required to rehabilitate and revegetate the land.

The primary objectives of this study were as follows:

- Identify areas requiring rehabilitation and revegetation;
- Identify any operational reasons for maintaining areas of bare ground;
- Assess the flora, fauna, historic heritage and Aboriginal heritage values of the disturbed areas;
- Determine the feasibility and treatments required for rehabilitation of these areas to promote revegetation by local native plant communities; and
- Determine timing of rehabilitation for identified sites and commence works where possible.

Hydro Tasmania, in consultation with the Department of Primary Industries, Parks, Water and Environment Conservation Management Branch and the Tasmanian Parks and Wildlife Service visited the area to identify sites that are required for ongoing operational use or require rehabilitation and revegetation. Identified sites were mapped and plans were prepared documenting treatments to be applied at each site.

The Lake Mackenzie Land Rehabilitation project has resulted in the identification of sixteen sites requiring treatment to achieve rehabilitation and revegetation with a total area of approximately 5 hectares.

Nine sites along the Parsons Canal access road that have shallow, stony well drained soils suitable for cultivation during the wetter period of late autumn or winter were treated in June 2013.

The remaining sites identified for rehabilitation treatments will be surveyed for Aboriginal heritage values prior to commencing treatments in 2014. Treatment of these areas will commence in late summer/autumn 2014.

One site is within the full supply level of Lake Mackenzie and will not be treated.

Results of rehabilitation treatments will be monitored for their effectiveness until self-sustaining native vegetation is established. Hydro Tasmania is committed to sustainable management of its land and water resources and will continue to rehabilitate land impacted by hydropower infrastructure as required.

Acknowledgements

Thanks to Michael Comfort of DPIPWE Conservation Management Branch, for time taken to help assess rehabilitation requirements for identified sites and helpful expertise in soils and erosion management.

Thanks to Chris Emms of Tasmanian Parks and Wildlife Service for input to and support of the project.

Thanks to Caleb Pedder for undertaking Aboriginal Heritage assessments.

Thanks to Hydro Tasmania Technical and Operations staff Peter Ford and Craig Emmett for their time, assistance and knowledge of the Fisher production system in identifying sites requiring rehabilitation, and ongoing operational requirements and issues.

Cover photograph:
Old claypit above Fisher Forebay to be revegetated in 2014

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List of Abbreviations and Acronyms

BOM	Bureau of Meteorology
DCO	Dry *Eucalyptus coccifera* woodland and forest
DPIPWE	Tasmanian Department of Primary Industries, Parks, Water and Environment
GPH	Highland Poa Grassland
HHE	Eastern Highland Heathland
HSE	Eastern Highland Sedgeland
MGH	Highland Grassy Moorland
PWS	Tasmanian Parks and Wildlife Service
RPP	Pencil Pine Rainforest
TSPA	Tasmanian *Threatened Species Protection Act 1995*
TWWHA	Tasmanian Wilderness World Heritage Area

1. Introduction

1.1 Background

The review of Hydro Tasmania's land and water management activities in the Mersey-Forth catchments identified the need to rehabilitate land disturbed during construction of Mackenzie dam and other infrastructure in the vicinity of Lake Mackenzie.

Lake Mackenzie is located on the Fisher River that flows through the Balmoral Moor in the north west of the Central Plateau of Tasmania, at an altitude of approximately 1100 m (Figure 1.1).

The Fisher Power Scheme, including Lake Mackenzie and dam and associated water conveyance infrastructure, was constructed in the late 1960's and early 1970's. Hydropower infrastructure at Lake Mackenzie is described in detail in the Mersey-Forth Water Management Review Report (Hydro Tasmania, 2011).

After construction of the scheme was completed, buildings and much evidence of works were removed leaving only features such as a series of concrete slabs. Some building and construction materials were buried on site. However a significant amount of waste (metal, plastic etc.) remains visible in the landscape.

Areas of land in the vicinity of Lake Mackenzie remain bare since the vegetation was removed and the ground disturbed during the construction of the dam, canals, pipelines and road infrastructure. This bare land is visible from publicly accessible areas and is subject to ongoing sheet and rill erosion by the action of wind, rain and ice. There is evidence in some locations where the original topsoil and vegetation has been scraped and windrowed within or adjacent to the disturbed sites.

Since the addition of the Central Plateau Conservation area to the Tasmanian Wilderness World Heritage Area (TWWHA) in 1989, the hydroelectricity infrastructure in the vicinity of Lake Mackenzie is within the TWWHA, on land vested in Hydro Tasmania.

1.2 Aim of study

The aim of the study was to determine the feasibility and scope of work required to rehabilitate and revegetate disturbed land in the vicinity of Lake Mackenzie.

The primary objectives of this study were as follows:

- Identify areas requiring rehabilitation and revegetation;
- Identify any operational reasons for maintaining areas of bare ground;
- Assess the flora, fauna, historic heritage and Aboriginal heritage values of the disturbed areas;
- Determine the feasibility and treatments required for rehabilitation of these areas to promote revegetation by local native plant communities; and
- Determine timing of rehabilitation for identified sites and commence works where possible.

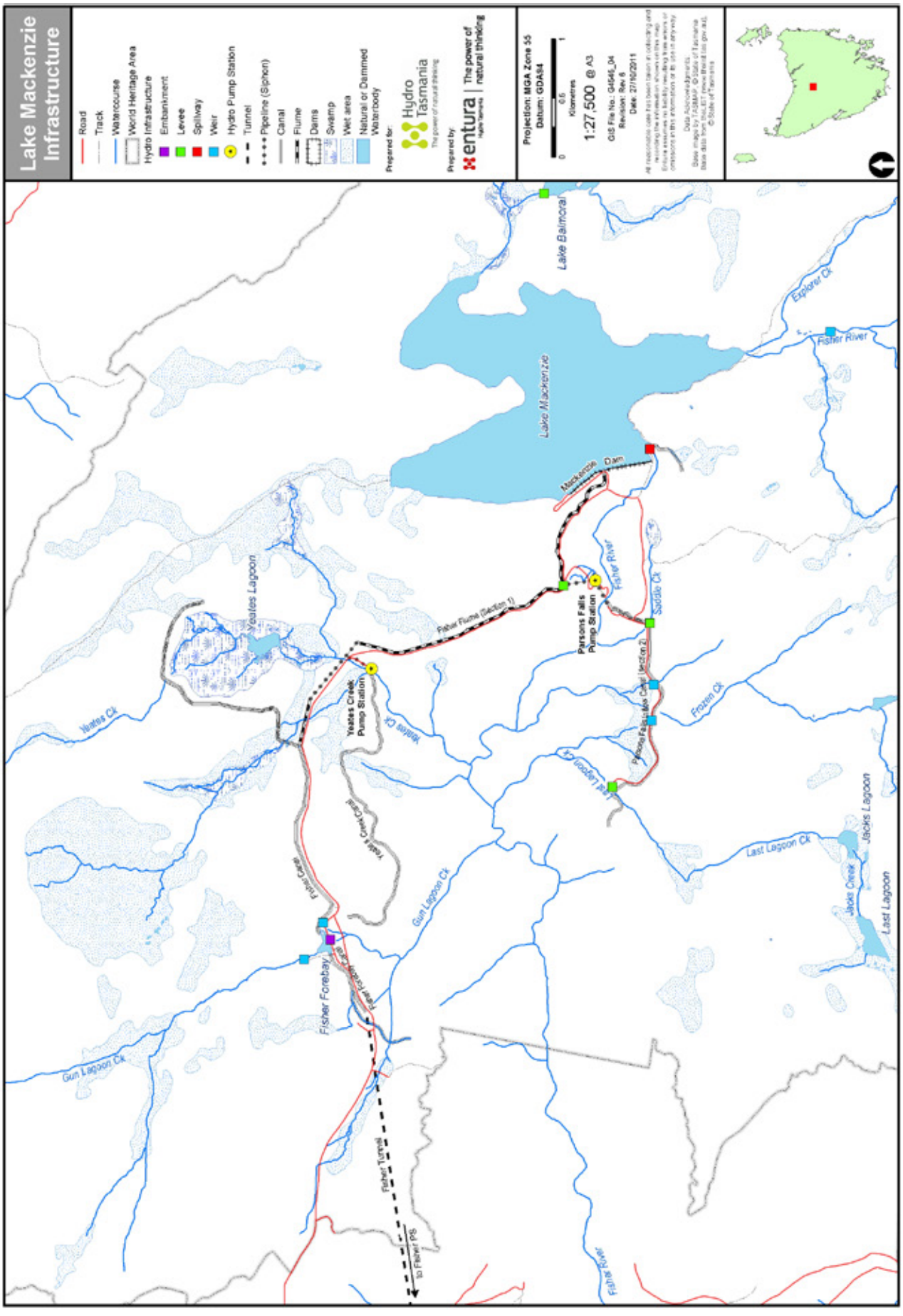

Figure 1.1: Infrastructure in the vicinity of Lake Mackenzie

2. Process

A number of steps were taken to identify sites that require rehabilitation and to determine the treatments required to achieve successful rehabilitation at those sites. These steps are described below.

2.1 Identifying sites that require rehabilitation

2.1.1 Site visits

Sites for rehabilitation and areas required for ongoing operational and maintenance requirements were identified through site visits by Hydro Tasmania Technical and Operations staff from Gowrie Park. Through their experience and knowledge of the infrastructure, its history and current operational and maintenance requirements they were able to identify:

- Those areas that have not revegetated since construction;
- Ongoing usage requirements for some sites;
- Sites that had been decommissioned; and
- Ongoing impacts of operations relevant to the potential success of rehabilitation treatments.

Areas were identified that are required for operational, maintenance and for public access purposes. Other operational issues such as spill events were identified that have and continue to impact on success of revegetation of some areas.

Seventeen sites with a total area of approximately 5 hectares were identified for treatment aimed at rehabilitation and revegetation or formalising ongoing operational or public access uses.

These sites were grouped based on future use requirements, soil types, surrounding vegetation communities and drainage issues.

2.1.2 Digital mapping of sites

Sites identified during field visits were then mapped using available digital globe satellite imagery, allowing for estimation of treatment areas and documentation of sites for tendering by civil contractors.

2.1.3 Stakeholder collaboration

As the area falls within the Great Western Tiers Conservation Area and the TWWHA, the key stakeholders identified for collaboration on this study were the major land managers and regulators for the area, Department of Primary Industries, Parks, Water and Environment (DPIPWE) and Parks and Wildlife Service (PWS). Because of the rich cultural and natural values of the area the Tasmanian Aboriginal community was also consulted through Entura's Aboriginal Heritage consultant who completed site assessments.

2.2 Determining treatments required for site rehabilitation

Treatments required to rehabilitate identified sites depend on the identified aim of rehabilitation, the local climate, soils and effects of water flow, the surrounding vegetation types and flora and fauna species present in the area. The potential for negative impacts of planned treatments on these and heritage values must also be considered and managed.

2.2.1 Aim of rehabilitation and elements for success

The identified aim of rehabilitation in this area is to create a suitable environment to promote the development of a self-sustaining native vegetation community that is consistent with the surrounding vegetation.

In the harsh alpine environment around Lake Mackenzie, creating conditions favourable for establishing and supporting plant growth can be difficult. The key elements for success are:

- Understanding and managing water flows across the sites to minimise surface erosion and scouring;
- Providing freely draining soils and microenvironments protected from erosion and the ravages of frost heave or needle ice; and
- Ensuring adequate nutrients and a source of local provenance seed are applied to promote establishment and growth of native vegetation.

2.2.2 Climate and soils

Climate and soil conditions, as well as the underlying geology, are important factors when determining rehabilitation options in alpine areas. Climate averages from the nearest Bureau of Meteorology (BOM) recording station at Cradle Valley were accessed as this site is indicative of the climate at Lake Mackenzie.

2.2.3 Flora

Available mapping of vegetation communities (TASVeg) and records of flora species (Natural Values Atlas - NVA) within the area were assessed and, during field visits, correlated with observations of community types and species in the vicinity of sites identified for rehabilitation.

2.2.4 Fauna

During field visits suitable habitat for the Tasmanian Devil (*Sarcophylus harrisii*) and Spotted Quoll (*Dasyurus maculatus*) was assessed. Animal droppings were also noted.

2.2.5 Heritage

Hydro Tasmania's historic heritage database was accessed to check for the heritage value of remnants of construction activities.

2.3 Scope of treatments for rehabilitation

The scope of treatments to achieve rehabilitation of identified sites include site preparation, collection and sowing of local native seed and/or seedlings, protection of the soils and vegetation from erosion and impacts of browsing animals. Monitoring of revegetation and correction of problems that may limit the success of revegetation will be ongoing.

Site preparation will focus on establishing suitable drainage and, where available, windrowed material will be respread to create deeper, freely draining soils. Where no windrowed soil is available, in situ soils will be ploughed along contour to reduce sheet erosion and promote water infiltration and retention of nutrients.

Water flows across identified sites and poorly drained areas within these sites are significant factors limiting revegetation. Ongoing erosion of exposed soil/clay may also contribute to turbidity in receiving waterways.

Water flowing across sites will, where necessary and practicable, be directed into rock lined water courses with sediment settling ponds and wetland areas formed in low lying areas along drainage lines, in order to minimise sediment delivery to waterways.

At most sites, soil will be cultivated across the slope with the aim to improve site drainage, to control water flows and minimise erosion issues, and to create freely draining soils to minimise ice formation. Some surface protection will be provided by using available rock and slashed vegetation spread over the surface to provide protected niches for plant growth.

Soil nutrients will be augmented by application of fertiliser (N:P:K 14:16:11) at 350 kg/hectare to promote establishment and growth of seedlings.

Once prepared, sites will be seeded (approximately 5kg/hectare) and/or planted with local provenance native flora species. Seed for sowing directly or producing seedlings for planting will be collected as outlined in Section 3.6.

Protection of the soil will be achieved by spreading available rock and/or plant material (slash) collected from within and immediately adjacent to the sites identified for rehabilitation and during roadside and canal vegetation maintenance activities.

Animal proof fencing will be installed around areas that can be practicably fenced within each treated area (unless otherwise indicated). Fencing will be removed once self-sustaining native vegetation is established.

2.4 Environmental and safety management plans

While there are ongoing environmental impacts of degraded land, treatments to rehabilitate this land can have associated environmental impacts and safety risks. Environmental and safety management plans were developed to avoid or mitigate these risks.

3. Outcomes

3.1 Stakeholder collaboration

The Geodiversity Section Leader from DPIPWE visited the area in February 2013 with Hydro Tasmania and helped identify soil and drainage issues at sites identified for rehabilitation and made suggestions for treatments for sites to create conditions favourable to plant growth.

The Geodiversity Section Leader also reviewed the environmental management plans for the works completed in 2013 along Parsons Canal Road and those planned for 2014 along the Lake Mackenzie Road.

The PWS Manager (Great Western Tiers, Mersey area) provided advice on PWS approvals requirements, reviewed the environmental management plan for the works completed along Parsons Canal Road in 2013, and will be further consulted in relation to areas to be used for visitor parking and ongoing operational use. The PWS manager also provided advice on the use of the area that anglers and bushwalkers access for recreation.

3.2 Climate and soils

At Cradle Valley, mean annual maximum temperature is 10.6˚C, mean annual minimum temperature is 2.3˚C, mean annual rainfall is 2650 mm, mean number of rain days (> 1 mm) is 155, and there are more than 250 days where temperatures can fall below 2˚C creating potential for frost formation in suitable locations. Monthly climatic averages are shown in Figure 3.1.

The geology of the area is predominantly Jurassic dolerite and glacially derived sediments, till and deposits. Soils are stony, gravelly, gradational clay soils derived from weathering of dolerite. At higher elevations (>500m) these soils are known to strongly retain phosphorus making this element potentially limiting to plant growth (Laffan and McIntosh, 2005).

Soils are moderately susceptible to sheet and rill erosion from rain and overland water flows, however more significant is the constant movement of exposed soil resulting from the action of needle ice or frost heave. Frosts can potentially occur during 7-9 months of the year from April to December.

Soil treatments therefore need to aim to manage local surface water drainage and to produce substantial areas of freely draining soil protected from frost heave. This can be achieved through contour ploughing, combined with the application of as much protection from frost formation as possible provided through placement of rock and slashed vegetation over cultivated soils.

Because much of the organic topsoil materials have been removed from disturbed sites, spreading of available windrowed soils over treated sites and application of low rates of fertiliser are required to provide suitable levels of nutrient availability for seedling germination and establishment.

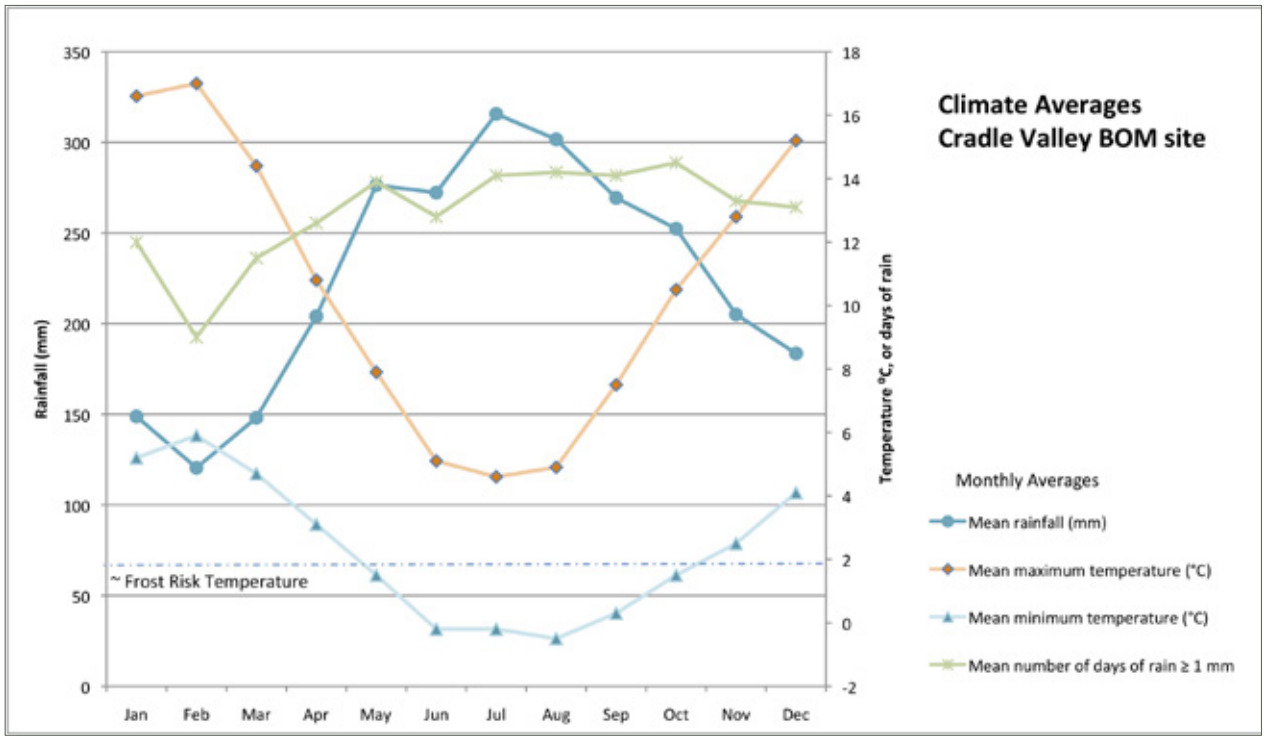

Figure 3.1: Climate Averages from nearby Cradle Valley

3.3 Flora

Patterns of vegetation community type and distribution of flora species in the area are largely determined by the limitations of the soils, climate and localised drainage patterns. In the Lake Mackenzie area, freer draining soils on rises and slopes support growth of drier Eucalypt woodland and forest communities. Dry *Eucalyptus coccifera* woodland and forest (DCO) occurs in these areas. Lower lying, poorly drained areas and areas subject to regular frost are vegetated with highland treeless vegetation types ranging between heathland (Eastern Highland Heathland - HHE), moorland/sedgeland (Highland Grassy Moorland – MGH; Eastern Highland Sedgeland – HSE) and grassland types (Highland Poa Grassland – GPH). Wet gullies such as the Fisher River Valley support wet Eucalypt forest and rainforest communities, including Pencil Pine Rainforest (RPP).

Highland Poa grassland (GPH), Highland Grassy Moorland (MGH) and Pencil Pine Rainforest (RPP) are listed as threatened vegetation communities under the *Tasmanian Nature Conservation Act 2002*.

Flora species recorded on the NVA in the area are listed in Appendix A. *Viola cunninghammii* (rare, *Threatened Species Conservation Act* – TSPA) is the only listed species recorded within 1 km of identified hydroelectricity infrastructure and the areas identified for rehabilitation.

The predominant vegetation types observed in the vicinity of sites identified for rehabilitation were Dry *Eucalyptus coccifera* woodland and forest (DCO), Eastern highland sedgeland (HSE) and Eastern highland heathland (HHE). Highland Grassy Moorland (MGH) and Highland Poa Grassland (GPH) are also present in the vicinity of some sites.

Flora species observed within and adjacent to areas identified for rehabilitation are identified in Appendix A. No threatened species were observed within or adjacent to disturbed areas.

Available seed of local native flora species were collected from some of these species in Autumn 2013 (permit FL 13055). Seed collected include seed of *Acacia mucronata*, *Acaena novae-zelandiae*, *Eucalyptus coccifera*, *Leptospermum lanigerum*, *Leptospermum rupestre*, *Ozothamnus hookeri*, *Poa gunnii* and *Tasmannia lanceolata*. This mixture of species is consistent with species that occur within DCO, HHE, HSE and GPH vegetation community types. Further seed will be collected in summer of 2014 in order to supply sufficient seed for sites to be rehabilitated in 2014 and to increase the species range of seed collected and sown.

Two introduced weed species were observed in the vicinity of sites for rehabilitation. Ragwort (*Senecio jacobaea*) was observed occasionally along the roadside but not within sites to be rehabilitated. Spear thistle (*Cirsium vulgare*) rosettes were observed on the northern side of the road at Parsons Road #2 site (PR02 see Map D.1 in Appendix D).

There has been an ongoing program of weed management in the area particularly targeting ragwort, but there is potential for works to introduce or spread weeds within the sites. Contractors for rehabilitation treatments will be required to ensure that all machinery and equipment is cleaned to be visibly free of earth and vegetation prior to entry to the TWWHA and between sites, consistent with the Keeping it Clean Hygiene Manual (Allan and Gartenstein, 2010).

3.4 Fauna

Suitable habitat for the Tasmanian Devil (*Sarcophylus harrisii*) and Spotted Quoll (*Dasyurus maculatus*) exists in the vicinity of sites identified for rehabilitation. However, neither scats nor specific habitat (den sites) were observed in areas identified for rehabilitation.

Droppings of rabbits, wallaby and wombats were observed within many of the areas identified for rehabilitation, associated with small patches of close cropped vegetation, however no burrows were observed within these areas. Where practicable, areas will be fenced to minimise animal browsing of new seedlings.

Sites will be inspected annually to assess impacts of browsing on regrowth and to check the integrity of fences. Repair of fences will occur as required.

3.5 Heritage

Remnants of construction activities (concrete slabs and waste materials) found within sites identified for rehabilitation were assessed as low heritage value. The recommended treatment of these sites is to "Retain while feasible as evidence of former patterns of use". Concrete pads will be retained for operational and maintenance purposes as required, while surrounding areas will be rehabilitated by removal of visible waste materials, and revegetated where possible.

Areas around Lake Mackenzie and associated waterways are rich in Aboriginal artefacts. As the work required to rehabilitate identified areas might require ground disturbance the assessment of Aboriginal heritage values was undertaken in 2013 to determine if there were any Aboriginal heritage values present (Pedder, 2013). Areas identified for treatment in 2014 will be surveyed in summer 2013-14.

Most of the areas to be rehabilitated in 2013 were not characteristic of sites where there is the presence of Aboriginal heritage values (Pedder, 2013). However, Aboriginal artefacts were observed on one site. The area on the northern side of the road at Parsons Road #2 site (PR02 see Map D.1 in Appendix D) had 13 artefacts visible within its boundary. Most were on the northern edge of the cleared area near the vegetation. Treatment of this site will be limited to hand spreading of seed and fertiliser. Ground disturbing activities in this area will be avoided.

3.6 Plan of works

The Lake Mackenzie Land Rehabilitation project has resulted in the identification of sixteen sites requiring treatment to achieve rehabilitation and revegetation with a total area of approximately 5 ha.

Nine sites along the Parsons Canal access road that have shallow, stony well drained soils suitable for cultivation during the wetter period of late autumn or winter were treated in June 2013. The treatments applied at each of these sites are summarised in Appendix B and associated maps in Appendix D.

These sites will be monitored for integrity of browser proof fencing, soil erosion, weeds and native vegetation growth until a self-sustaining cover of native vegetation has established. Fencing repairs, weed treatment and additional fertiliser and seed applications will be done as identified.

The remaining sites identified for rehabilitation treatments will be surveyed for Aboriginal heritage values prior to commencing treatments in 2014. Treatment of these areas will commence in late summer/autumn 2014. The planned treatments to be applied at each of these sites are summarised in Appendix C and associated maps in Appendix E.

Two sites with more complex drainage issues and clay soils, that are difficult to cultivate and that could be degraded by cultivation when wet, will be treated in late summer to early autumn 2014.

A further four sites that require resolution of future requirements for Hydro Tasmania's operational use and public access uses, rubbish removal or drainage issues will be treated as soon as practicable on resolution of the outstanding issues.

One site where revegetation has previously been attempted requires resolution of drainage issues and operational issues that result in episodic spill events before rehabilitation can be attempted.

One site is within the full supply level of Lake Mackenzie and will not be treated.

Results of rehabilitation treatments will be monitored for their effectiveness until self-sustaining native vegetation is established.

3.7 Environmental and safety management plans

While there are ongoing environmental impacts of degraded land, treatments to rehabilitate this land can have associated environmental impacts and safety risks. The following key risks and measures to avoid or mitigate these risks were identified for proposed treatments.

3.7.1 Safety risks

Working at high altitudes in a remote area carries risks of exposure and difficulty of recovery in the event of an accident. In addition, heavy rainfall in the area can result in water spilling from infrastructure resulting in closure of access roads, potentially leading to stranding for significant periods. All personnel working on this project must carry and use suitable clothing for all potential weather conditions, have support through adequate communications equipment (access to satellite phone), remote area first aid training and comprehensive first aid kit. The location of the emergency shelter at Mackenzie Dam should be made known to the working crews.

3.7.2 Environmental impacts

Cultivation and redistribution of windrowed soils may result in a temporary increase in turbidity to waterways. Contour cultivation is aimed at slowing water movement across sites, but where feasible, sediment settling basins will be incorporated where drainage management is identified as important for successful rehabilitation of identified sites.

Weeds and disease could be introduced to the area or spread between sites on dirty machinery and equipment. Contractors for rehabilitation treatments will be required to ensure that all machinery and equipment is cleaned to be visibly free of earth and vegetation prior to entry to the TWWHA and between sites, consistent with the Keeping it Clean Hygiene Manual (Allan and Gartenstein, 2010).

Collection of vegetation slash for protection of rehabilitated sites has potential to harm local vegetation and cause unacceptable visual impact. Branches of *Leptospermum sp.* and *Eucalyptus sp.* carrying seed pods are to be selectively collected from within 1 m of roadside drains along Lake Mackenzie Road and Parsons Canal Road, or from within 5m of the sites being treated with slash. No more than 20% of any plant is to be cut. Material is to be cut by hand, where practicable from parts of the plant that are least visible from roads or walking tracks. Branches are to be transported to sites as soon as practicable after cutting.

3.7.3 Aboriginal heritage

Aboriginal heritage values can be disturbed or destroyed by treatments involving ground disturbance. Treatment on the north side of the road of Parsons Road #2 site where Aboriginal artefacts are known to occur will be limited to hand spreading of seed and fertiliser. Ground disturbing activities in this area will be avoided.

4. Commitment and Way Forward

Following completion of initial treatments, each site will be monitored for success of plant establishment, presence of introduced weed species, erosion and sedimentation issues and the integrity and effectiveness of fencing in preventing browsing of young vegetation. Actions will be taken to address any identified issues that are compromising the success of stated aims of rehabilitation.

Hydro Tasmania is committed to sustainable management of its land and water resources and will continue to rehabilitate land impacted by hydropower infrastructure as required.

5. For More Information

The fact sheet for this study is available at **www.hydro.com.au/MFWMR-studies**.

To see all the Mersey-Forth Water Management Review technical and social studies go to **www.hydro.com.au/MFWMR-studies**.

Find out more about the Mersey-Forth Water Management Review at **www.hydro.com.au/MFWMR**.

6. References

Allan K. and Gartenstein S. 2010. *Keeping it Clean: a Tasmanian field hygiene manual to prevent the spread of freshwater pests and pathogens*. Natural Resource Management (NRM) South, Hobart, Tasmania.

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Appendices

A. Flora Species recorded on the Balmoral Moor

Species observed within and adjacent to sites identified for rehabilitation are marked

Species Name	Preferred Common Names	Observed
Abrotanella forsteroides	tasmanian cushion plant	
Acaena novae-zelandiae	common buzzy	Y
Acrothamnus montanus	snow beardheath	Y
Almaleea subumbellata	wiry bushpea	
Astelia alpina var. alpina	pineapple grass	Y
Athrotaxis cupressoides	pencil pine	Y
Baeckea gunniana	alpine heathmyrtle	
Baeckea leptocaulis	slender heathmyrtle	
Baloskion australe	southern cordrush	Y
Bellendena montana	mountain rocket	Y
Boronia citriodora	lemon boronia	
Boronia pilosa	hairy boronia	
Caladenia alpina	alpine finger-orchid	
Carpha alpina	alpine strawsedge	
Celmisia asteliifolia	silver snowdaisy	
Celmisia saxifraga	small snowdaisy	
Cirsium arvense(i)	Californian thistle	
Cirsium vulgare(i)	Spear thistle	Y
Cotula alpina	alpine buttons	
Diplarrena latifolia	western flag-iris	
Diplarrena moraea	white flag-iris	
Diselma archeri	dwarf pine	
Donatia novae-zelandiae	snow cushionplant	
Empodisma minus	spreading roperush	
Epacris gunnii	coral heath	
Epacris lanuginosa	swamp heath	
Epacris serpyllifolia	alpine heath	
Erigeron stellatus	star mountaindaisy	
Eucalyptus coccifera	snow peppermint	Y
Euphrasia collina subsp. diemenica	plain tufted-eyebright	
Euphrasia striata	shiny striped eyebright	

Species Name	Preferred Common Names	Observed
Exocarpos humifusus	mountain native-cherry	
Gaultheria tasmanica	tasmanian waxberry	Y
Geranium brevicaule	alpine cranesbill	Y
Gleichenia alpina	alpine coralfern	Y
Grevillea australis	southern grevillea	Y
Hydrocotyle sibthorpioides	shining pennywort	
Lagenophora stipitata	blue bottledaisy	
Leionema montanum	spreading waxflower	
Lepidosperma filiforme	common rapiersedge	
Leptospermum rupestre	mountain teatree	Y
Lycopodium fastigiatum	mountain clubmoss	
Microlaena tasmanica	tasmanian ricegrass	
Monotoca empetrifolia	mat broomheath	
Monotoca submutica	round-leaf monotoca	
Olearia erubescens	moth daisybush	
Olearia ledifolia	rock daisybush	
Olearia phlogopappa	dusty daisybush	Y
Olearia pinifolia	prickly daisybush	
Orites acicularis	yellow orites	Y
Orites revolutus	revolute orites	Y
Ourisia integrifolia	mountain whitebell	
Ozothamnus hookeri	scaly everlasting bush	Y
Pelargonium australe	southern storksbill	
Pentachondra pumila	carpet frillyheath	
Pentapogon quadrifidus var. parviflorus	lesser five-awn speargrass	
Plantago paradoxa	hairtuft plantain	
Poa gunnii	gunns snowgrass	Y
Podocarpus lawrencei	mountain plumpine	
Podolepis jaceoides	showy copperwire-daisy	

A. Flora Species recorded on the Balmoral Moor (continued)

Species observed within and adjacent to sites identified for rehabilitation are marked

Species Name	Preferred Common Names	Observed
Prasophyllum alpinum	alpine leek-orchid	
Prasophyllum mimulum	highland leek-orchid	
Prasophyllum suttonii	mauve leek orchid	
Pterygopappus lawrencei	sage cushionplant	
Ranunculus triplodontus	threetooth buttercup	
Richea acerosa	slender candleheath	Y
Richea scoparia	scoparia	Y
Richea sprengelioides	rigid candleheath	
Rubus gunnianus	alpine raspberry	
Rytidosperma diemenicum	tasmanian wallabygrass	
Schizacme montana	mountain mitrewort	
Schoenus apogon	common bogsedge	
Senecio jacobaea (i)	ragwort	Y
Senecio pectinatus	alpine groundsel	Y
Sprengelia incarnata	pink swampheath	Y
Tasmannia lanceolata	mountain pepper	Y
Thelymitra circumsepta	naked sun-orchid	
Velleia montana	mountain velleia	
Verbascum virgatum (i)	Great mullein	
Viola cunninghamii (rare, TSPA)	alpine violet	
Viola hederacea	ivy-leaf violet	
Xerochrysum subundulatum	orange everlasting	

(i) Introduced species

B. Lake Mackenzie Land Rehabilitation, Stage 1 Autumn 2013 – Work Scope

Site name and code (refer maps)	Area (m^2)	Peri-meter (m)	Aboriginal heritage	Area to be Fenced (m^2)	Rehabilitation Treatments (see maps for location and more detail)
Parsons Road 2 PR02 **Map D.1**	4690	404	13 artefacts visible within its boundary on the northern side of the road. Most were on the northern edge of the cleared area near the vegetation.	No fencing	Treatment of Parsons road site #2 on the north side of the road will be limited to hand spreading fertiliser (N:P:K 14:16:11 at 350 kg/ha) and seed (5 kg/ha) mixed with sawdust only. **No Ground disturbance to north of road at this site.** The smaller part of this site on the southern side of the road to be treated by cultivating along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350 kg/ha) and seed (5 kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock.
Parsons Road 3 PR03 **Map D.2**	650	151	none observed	~15 x 30	Cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350 kg/ha) and seed (5 kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, browser proof fence with wombat escape valve
Parsons Road 4 PR04 **Map D.2**	368	128	none observed	~8 x 20	As above
Parsons Road 5 PR05 **Map D.2**	390	132	none observed	~15 x 20	As above
Parsons Road 6 PR06 **Map D.3**	780	200	none observed	~20 x 20 and ~8 x 10	As above
Parsons Road 7 PR07 **Map D.4**	2360	408	none observed	~6 x 40	Spread available windrow material, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350 kg/ha) and seed (5 kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, browser proof fence with wombat escape valve. **Do not treat Blue Peaks walking track alignment** (start is marked by roadside cairn).
Parsons Road 8 PR08 **Map D.5**	885	191	none observed	~30 x 20	As above
Parsons Road 9 PR09 **Map D.6**	1555	296	none observed	~60 x 10	As above
Parsons Road 10 PR10 **Map D.7**	824	232	none observed	No fencing	Hand spread fertiliser (N:P:K 14:16:11 at 350 kg/ha) and seed (5 kg/ha) mixed with sawdust.
Total 9 sites	12502	2142		Area ~2830 m^2 Length ~670 m	~580 kg N:P:K 14:16:11 fertiliser. ~8 kg seed.

Notes for contractors:

Works are all within the Tasmanian Wilderness World Heritage Area (TWWHA) on land vested in Hydro Tasmania.
All machinery and equipment is to be cleaned and effectively free of earth and vegetation prior to entering the TWWHA.
Collection and laying of vegetation slash is to meet the following guidelines:

Branches of *Leptospermum* sp. and *Eucalyptus* sp. carrying seed pods are to be selectively collected from within 1 m of roadside drains along Parsons Canal Road, or from within 5 m of the sites being treated with slash. No more than 20 % of any plant is to be cut. Material is to be cut by hand, where practicable from parts of the plant that are least visible from the road or walking track. Branches are to be transported to sites as soon as practicable after cutting. Branches are to be laid perpendicular to the slope of the land and pinned in place using available rock.

C. Lake Mackenzie Land Rehabilitation, Stage 2, Summer 2014 – Work Scope

Site name and code (refer maps)	Area (m^2)	Peri-meter (m)	Aboriginal heritage	~Area for Treatment (m^2)	~Fencing Area/ Length	Rehabilitation Treatments (see maps for location and more detail)
Lake Mackenzie Rd Borrow LMR_B **Map E.9**	3770	355	none observed	1600	~2,800 m^2 ~280m	Create meandering drain with sediment ponds, rock line scours, Spread available windrow material from east and west edges, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence, repair roadside drain.
Fisher Intake Clay Pit FI_CP **Map E.8**	14660	727	To be surveyed	12100	~7360 m^2 ~480m	Spread available windrow material from east and west edges, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence.
Rising Main construction area RMCA **Map E.11**	17150	1018	To be surveyed	16700	~2760 m^2 ~650 m	NOTE: this site will not be treated until water flow across site can be managed effectively. This requires changed operation to reduce spills and upgraded drains to cope with spill events. Spread available mounds of material, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence.
Parsons Road 1 Public Parking Area PR01 **Map E.10**	930	206	To be surveyed	0	No Browser Fencing ~60m Bollard	Clean up surface construction materials, formalise area to west as public parking area (negotiate with PWS), works staging area.
Works Area 1 WA1 **Map E.12**	710	255	To be surveyed	600	~460 m^2 150m	Clean up surface construction materials – concrete, metal, plastics – and remove to an approved landfill or recycling. Receipt or certificate of disposal is required for all disposed waste. Formalise access to slab for use as stockpile/ works/storage area, rip remainder, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence.

Site name and code (refer maps)	Area (m^2)	Peri-meter (m)	Aboriginal heritage	~Area for Treatment (m^2)	~Fencing Area/ Length	Rehabilitation Treatments (see maps for location and more detail)
Works Area 2 WA2 **Map E.12**	2220	434	To be surveyed	2100	~2100 m^2 ~400m	Clean up surface construction materials – concrete, metal, plastics - and remove to an approved landfill or recycling. Receipt or certificate of disposal is required for all disposed waste. Formalise access to slab for use as stockpile/ works/storage area, rip remainder, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence.
Works Area 3 WA3 **Map E.12**	970	157	To be surveyed	600	~580 m^2 ~130m	Repair drain, formalise access for maintenance, rip remainder, cultivate along contour with excavator, hand spread fertiliser (N:P:K 14:16:11 at 350kg/ha) and seed (5kg/ha) mixed with sawdust, selectively cut and spread slash across slope, pinned with available rock, install browser proof fence.
Total **78 sites**	40410	3152		33700	Area ~16100 m^2 Length ~2100 m	~1200 kg N:P:K 14:16:11 fertiliser ~17 kg seed

Notes for contractors:

Works are all within the Tasmanian Wilderness World Heritage Area (TWWHA) on land vested in Hydro Tasmania except the northern section of the Lake Mackenzie Rd borrow pit which is on land managed by PWS.

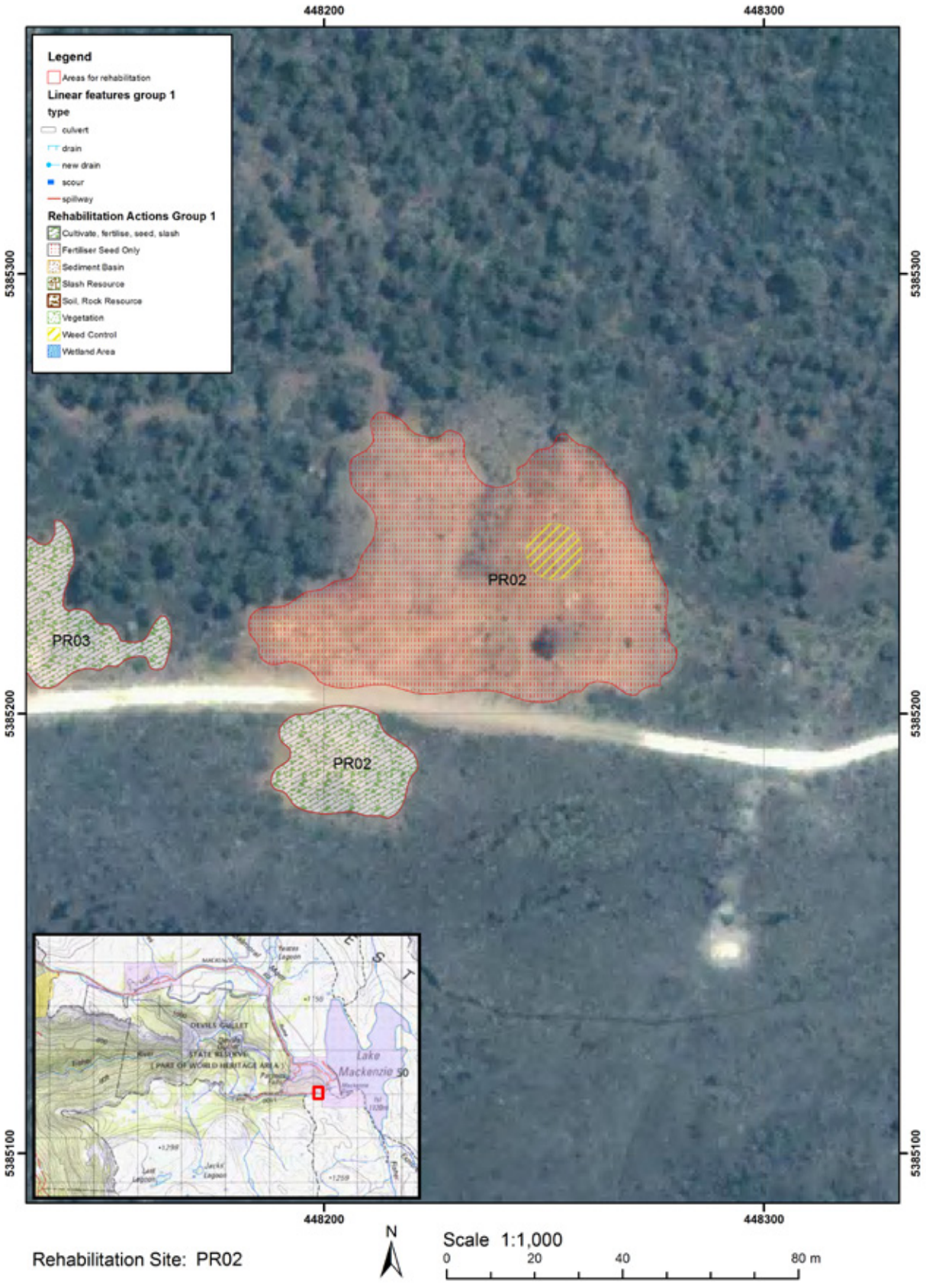
All machinery and equipment is to be cleaned and effectively free of earth and vegetation prior to entering the TWWHA.

Works at the Rising Main Construction Area (RMCA) should not be commenced until drainage and operation of scheme is amended to mitigate impacts of spill events.

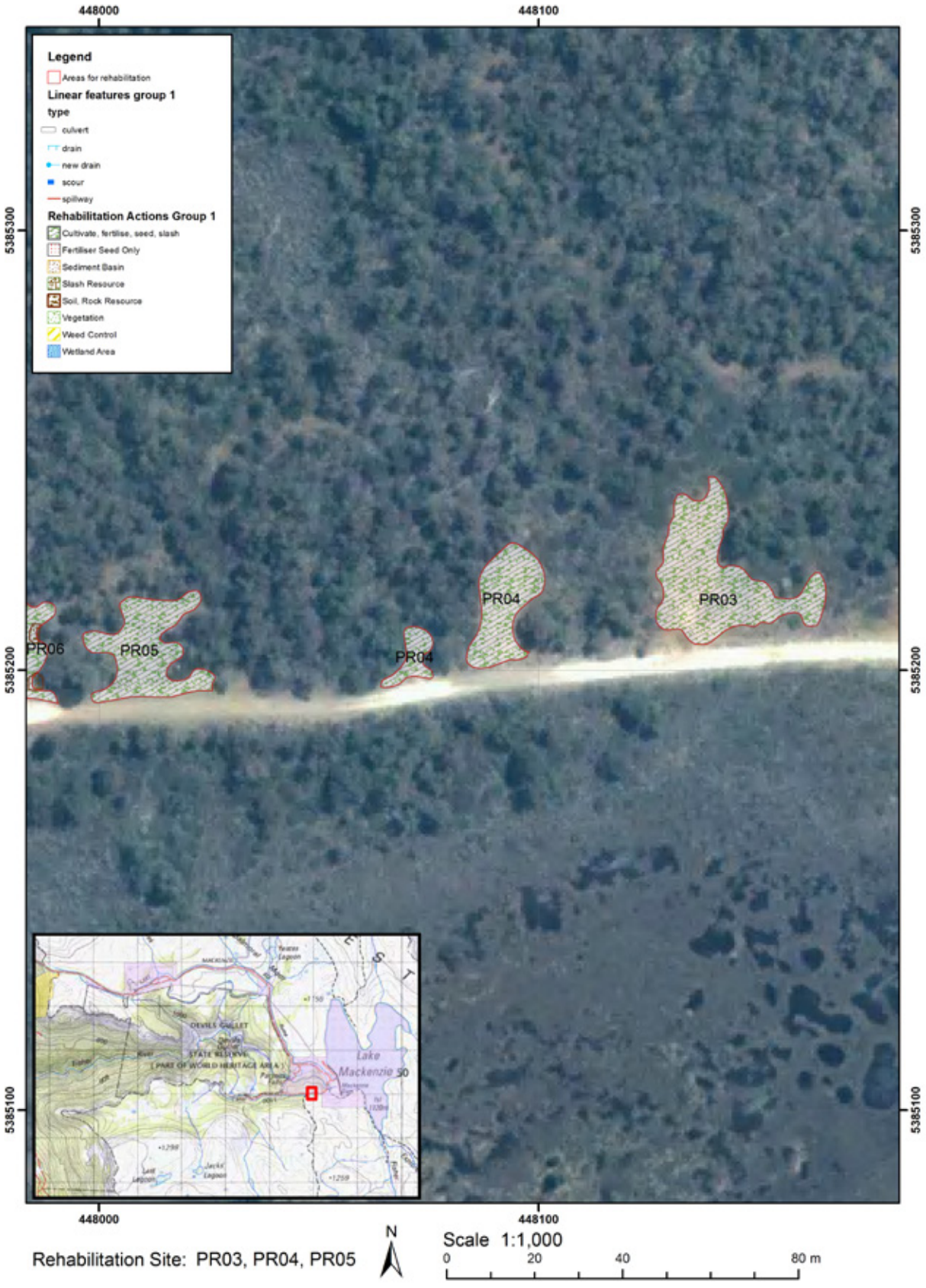
Collection and laying of vegetation slash.

Branches of Leptospermum sp. and Eucalyptus sp. carrying seed pods are to be selectively collected from within 1 m of roadside drains along Lake Mackenzie Road, or from within 5 m of the sites being treated with slash. No more than 20 % of any plant is to be cut. Material is to be cut by hand, where practicable from parts of the plant that are least visible from the road or walking track. Branches are to be transported to sites as soon as practicable after cutting. Branches are to be laid perpendicular to the slope of the land and pinned in place using available rock.

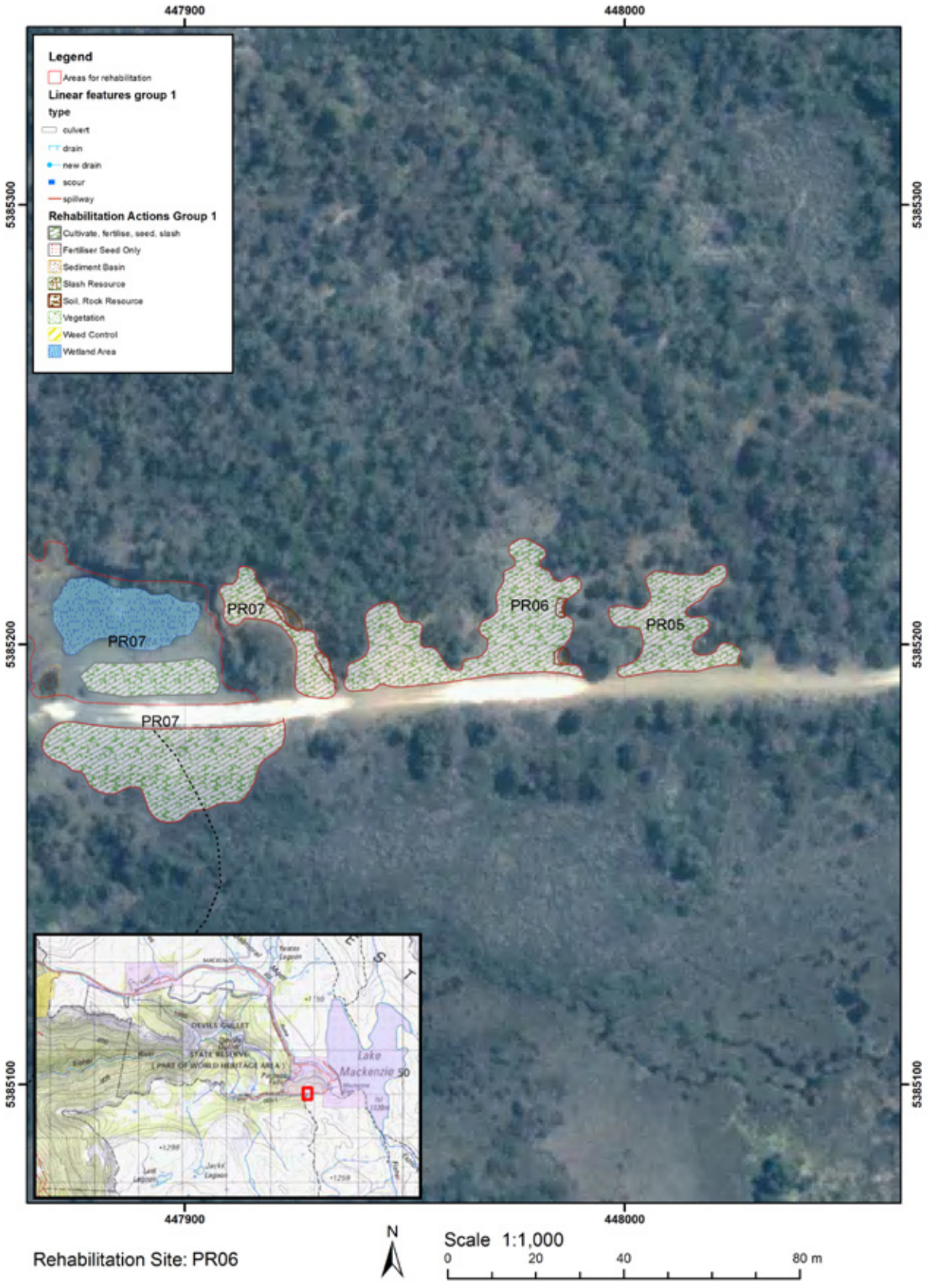
D. Lake Mackenzie Land Rehabilitation, Stage 1 Autumn 2013 Maps



Map D.1: Rehabilitation Site PR02



Map D.2: Rehabilitation Sites PR03, PR04 & PR05



Map D.3: Rehabilitation Sites PR06

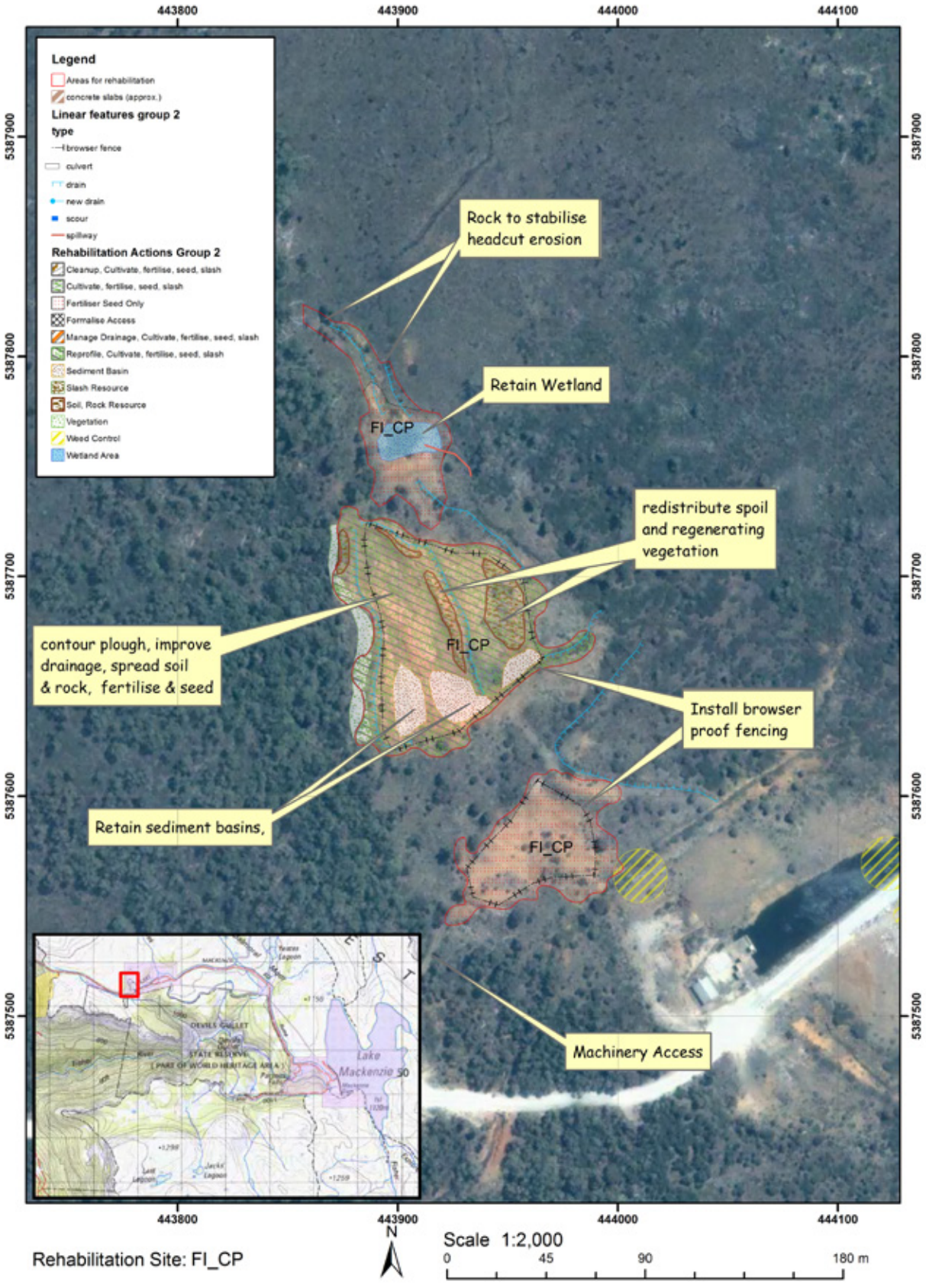
Map D.4: Rehabilitation Sites PR07

Map D.5: Rehabilitation Sites PR08

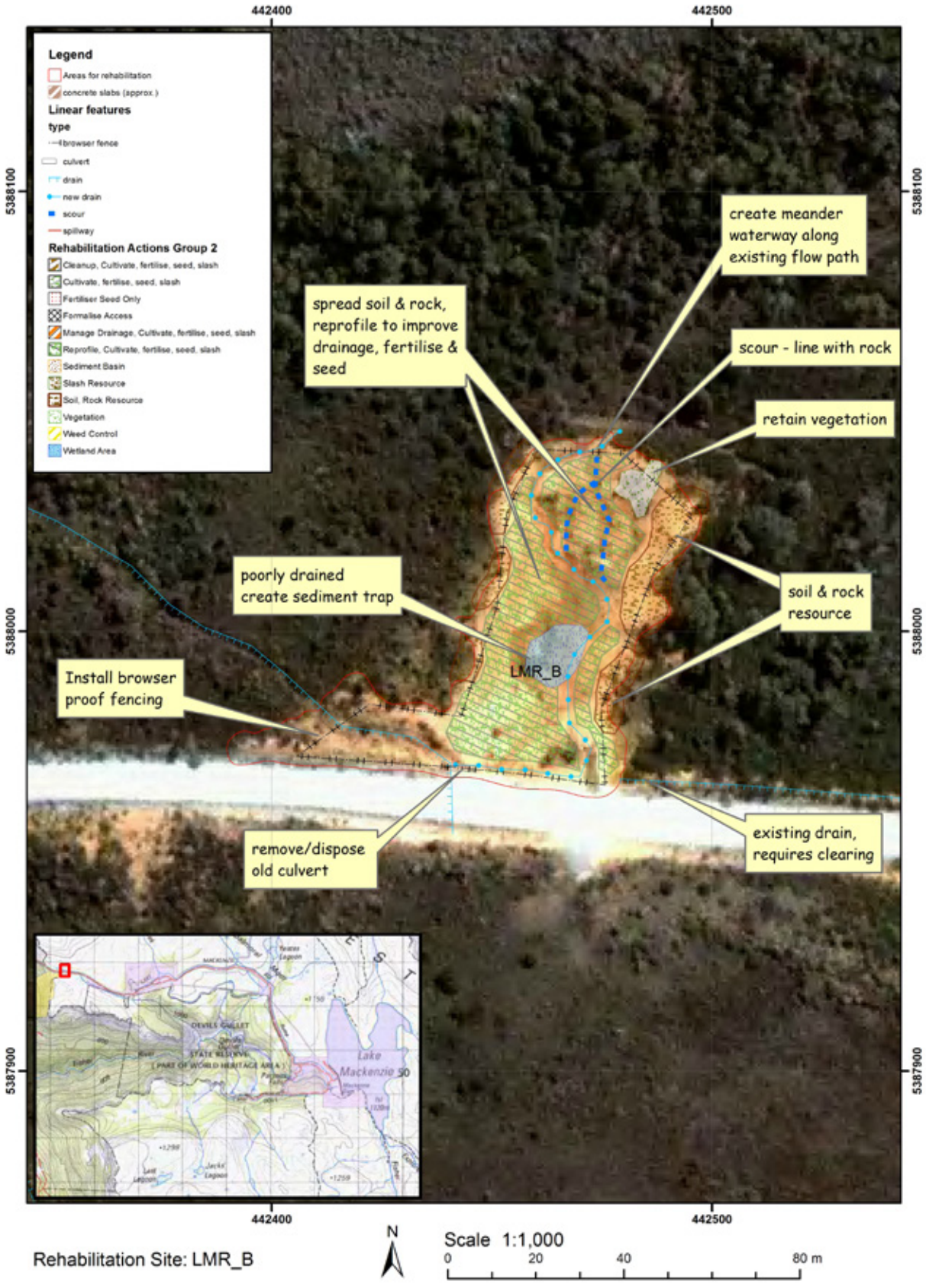
Map D.6: Rehabilitation Sites PR09

Map D.7: Rehabilitation Sites PR10

E. Lake Mackenzie Land Rehabilitation, Stage 2 Summer 2014 Maps

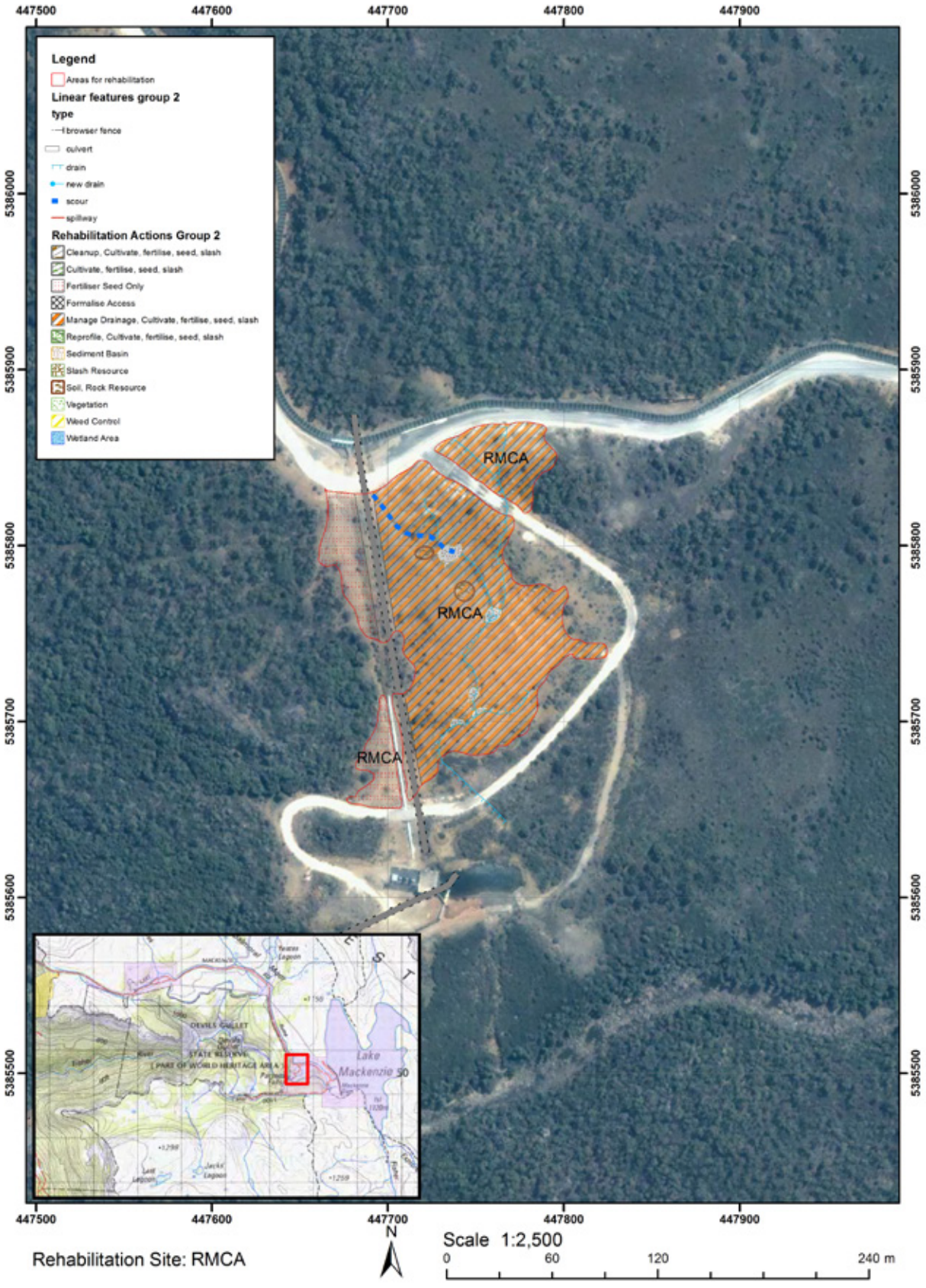


Map E.8: Rehabilitation Site FI_CP

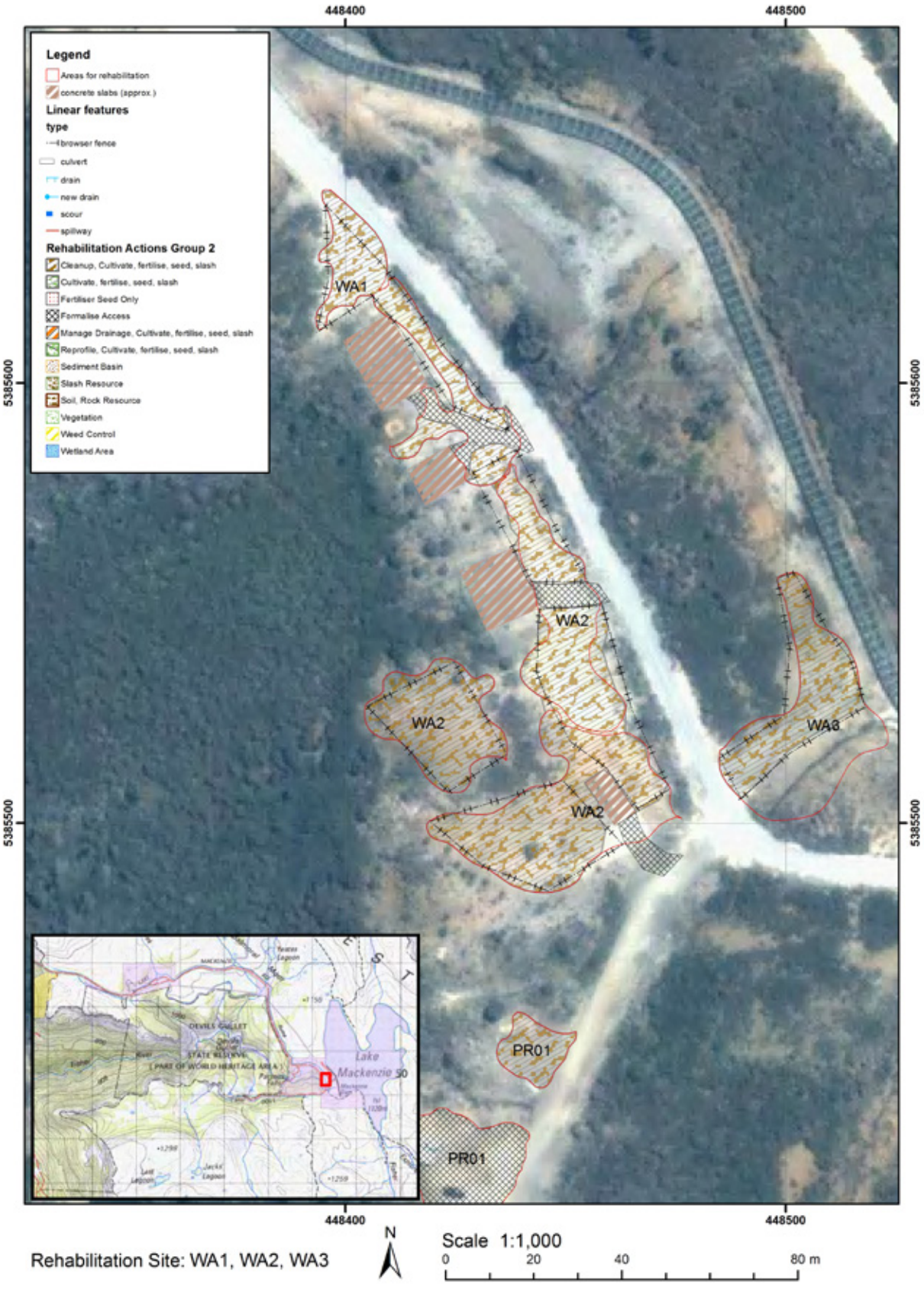


Map E.9: Rehabilitation Site LMR_B

Map E.10: Rehabilitation Site PR01



Map E.11: Rehabilitation Site RMCA



Map E.12: Rehabilitation Sites WA1, WA2 & WA3

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