



ACT
Government

Territory and Municipal Services

December 2014 - 2017

MOLOGLO RIVER RESERVE (KAMA) OPERATIONAL PLAN

MOLONGLO RIVER RESERVE (KAMA)

CANBERRA NATURE PARK

About this Plan

This Plan has been developed to help guide on-ground works and activities that will implement key components of:

- the Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (ACTPLA 2011; NES Plan);
- the Molonglo Adaptive Management Strategy (TAMS 2013);
- Molonglo River Reserve Plan of Management (*in prep*);
- the ACT Nature Conservation Strategy 2013-2023 (ESDD 2013);
- the ACT Strategic Bushfire Management Plan (ESA 2009);
- the ACT Weeds Strategy 2009-2019 (DECCEW 2009);
- the ACT Pest Animal Management Strategy 2012-2022 (ESDD 2009); and
- numerous ACT action plans, strategies and policies.

The Plan is designed to be used in conjunction with:

- the Molonglo River Reserve and Offset Areas Ecological Management Guidelines (TAMS *in prep*);
- the Procedures Manual for Monitoring Matters of National Environmental Significance in the Molonglo Conservation Areas (Sharp and Milner 2014);
- the Molonglo River Park Concept Plan Report (Hassell 2012);
- the Molonglo Development Fire Management Strategy (TAMS *in prep*);
- the Ecological Guidelines for Fuel and Fire Management Operations (ACT Government 2012), and
the Regional Fire Management Plan (RFMP), the Bushfire Operation Plan (BOP) and the Environmental Weeds Operation Plan (eWOP).

The Plan is the primary planning tool for providing for adaptive management approaches based on the results of monitoring, evaluation and review. Justification and further information on management protocols and methods identified in the Operational Plan are found in the above documents.

This Plan will be reviewed every **3 years** and will be put into effect through works programs, which will be reviewed and updated annually.

Background

Kama was established as a nature reserve and part of Canberra Nature Park in 2008. It is listed on the ACT Heritage Register as Kama Woodland/Grassland, Belconnen and consists of Blocks 1419 and 1386, Belconnen District. The reserve is situated between the lower Molonglo River and the Belconnen Woodlands.

The NES Plan identifies Kama as an offset site (NES Patches A1, A2, B1, B2, B3 and O1). The area will be incorporated into the Molonglo River Reserve for which a statutory Plan of Management is being

prepared in 2014. The new Molonglo River Reserve will include two existing reserves (Lower Molonglo River Nature Reserve and Kama Nature Reserve) and a new section that includes the river corridor up to Scrivener Dam.

The Molonglo River Reserve has been divided into three sections, including a Rural Section (773 ha), Urban Section (581 ha) and Kama (155 ha) (Figure 1). There is a Plan of Management for the Lower Molonglo River Nature Reserve (ACT Government 2001)¹ and a separate Operational Plan for the Urban Section (the Park; ACT Government in prep.). Suburbs are to be developed to the east of the Kama reserve, beyond a buffer, as part of the Molonglo Stage 3 development (within the next 20 years). The buffer zone will be of sufficient width² to provide protection against urban edge effects and provide for fire management to avoid adverse environmental impacts on threatened species and communities within Kama. Kama will be zoned as a Strategic Firefighting Advantage Zone (SFAZ) and will be managed using ecological management principles that are consistent with the conservation management objectives for the reserve.

Currently, land to the east and west of Kama is dominated primarily by mixed native and exotic vegetation, some of which is used for agriculture.

Conservation Values

Kama (154.6 ha) is part of a key corridor between the Molonglo River and the Belconnen Woodlands (Figure 1). It protects three heritage sites, 118 ha of high quality critically endangered Yellow Box - Blakely's Red Gum Grassy Woodland (BGW), 36.6 ha of endangered Natural Temperate Grassland (NTG), populations of the Pink-tailed Worm-lizard (PTWL), several rare plant species and is a key breeding and foraging area for several species of birds including Superb Parrot, Swift Parrot, and other declining woodland birds (Figure 2).

Land Use History

From the 1970's until 2009 Kama was managed by the Parks and Conservation Service and agisted to an adjoining lessee and grazed by cattle. The area is currently strategically grazed under the instruction of PCS staff for positive ecological outcomes.

There are management tracks within Kama, including boundary tracks, a major service track running north-south and several grassed tracks providing access and sign-posted walking tracks for recreational use (Figure 3). The ACT Government is currently investigating where earth fire trails can be appropriately positioned outside the Reserve for the purposes of fire suppression and fuel management.

The lower half of Kama was burnt in the 2003 wildfire and the north-western corner was burnt during a wildfire in 1985 (Figure 4). There have been planned burns in 2010 and an ecological burn is planned for 2015 in NES Patches A1 and A2.

Exploded ordnance waste has been found within the Molonglo River Valley, including sections of the Kama Nature Reserve through to Coppins Crossing Road. While no unexploded ordnances have been

¹ The Lower Molonglo River Corridor Management Plan 2001 will be subsumed into the Molonglo River Reserve Management Plan 2014-24.

² Buffer width will be determined as part of the final planning and design framework - Stage 3 - EPD.

found in Kama, there remains the possibility that they may be encountered in the future given two were found in December 2014 close to the eastern boundary. An investigation of 10% of the reserve is planned for 2015.

Ecological Values

Connectivity

Kama is a key connectivity link from Black Mountain and Bruce Ridge through the Belconnen woodlands (The Pinnacle, Mount Painter, Aranda Bushland nature reserves) to the Molonglo River corridor and Murrumbidgee River (Figure 1 and 5). Kama is the only lowland reserve in the ACT that links forest (in Kama North and The Pinnacle) through woodland and grassland (Kama) to riparian ecosystems (in the Molonglo River; Figure 1 and 5).

Ecological communities

Kama contains two vegetation communities, both of which are threatened (Figure 2; Table 1).

Table 1: Threatened ecological communities in Kama (Figure 2)

Ecological Community	Cwlth*	ACT**	NSW***	Area	NES Patches
Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (Natural Temperate Grassland): Kangaroo Grass - Wallaby-grass Moist Tussock Grassland (Tableland Moist Tussock Grassland)	Endangered	Endangered		36.6ha	A1, A2
White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland)	Critically endangered	Endangered	Endangered	118 ha	B1, B2, B3, O1

Flora

No threatened plant species have been recorded in Kama. Rare plant species (protected under the Nature Conservation Act) include *Indigofera adesmiifolia* (Leafless Indigo), *Dianella longifolia* (Smooth Flax-lily), *Plantago gaudichaudii* (Narrow Plantain) and *Zornia dyctiocarpa* (Zornia) (Figure 2).

Fauna

Kama provides a diversity of habitats for several threatened and declining species (Table 2). It forms an important link for birds and other fauna between Belconnen Woodlands and the Molonglo River and beyond (Figure 5).

Table 2: Threatened or declining fauna in Kama

Scientific Name	Common Name	Cwith*	ACT**	NSW***	Notes
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	Vulnerable	Vulnerable	Vulnerable	6 ha of habitat
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable	Vulnerable	Vulnerable	Foraging habitat
<i>Lathamus discolor</i>	Swift Parrot	Vulnerable	Vulnerable	Endangered	Foraging habitat
<i>Daphoenositta chrysoptera</i>	Varied Sitella		Vulnerable	Vulnerable	Breeds in Kama
<i>Climacteris picumnus</i>	Brown Treecreeper		Vulnerable	Vulnerable	Breeds in Kama
<i>Lalage sueurii</i>	White-winged Triller		Vulnerable		Breeds nearby
<i>Hieraaetus morphnoides</i>	Little Eagle		Vulnerable	Vulnerable	Foraging habitat and breeds nearby
<i>Neophema pulchella</i>	Turquoise Parrot			Vulnerable	Uncommon visitor to the ACT
<i>Chthonicola sagittata</i>	Speckled Warbler			Vulnerable	Regionally declining
<i>Petroica phoenicea</i>	Flame Robin			Vulnerable	Regionally declining
<i>Petroica boodang</i>	Scarlet Robin			Vulnerable	Regionally declining
<i>Stagonopleura guttata</i>	Diamond Firetail	Near threatened		Vulnerable	Breeds in Kama Regionally declining
<i>Aphelocephala leucopsis</i>	Southern Whiteface				Breeds in Kama Regionally declining
<i>Callocephalon fimbriatum</i>	Gang Gang			Vulnerable	Regionally declining
<i>Artamus cyanopterus</i>	Dusky Woodswallow				Breeds in Kama Regionally declining
<i>Artamus superciliosus</i>	White-browed Woodswallow				Regionally declining
<i>Falcunculus frontatus</i>	Crested Shrike-tit				Regionally declining

*Australian Government Environment Protection and Biodiversity Conservation Act 1999

**Nature Conservation Act 1980 (ACT)

***National Parks and Wildlife Act 1974 (NSW)

Canberra Ornithologists Group

A full list of flora and fauna surveyed in the reserve is included in Appendix A and B.

Geodiversity

The landform comprises lower slopes and footslopes of the Pinnacle through to the Molonglo River. The soils on this site are derived from shallow marine and terrestrial deposition and major volcanism (Abell 2007). These soils are typically strongly acid with a low fertility and a low waterholding capacity. Subsoils have a low permeability. The soils are susceptible to moderate mass movement (terracing), sheet erosion, run-off and localised shallow soils (Jenkins 2000).

Cultural Heritage Values

Identified heritage places and objects

There are three recognised Aboriginal Places of significance (Figure 6; Site names: CLB12, MOLIF5 and MOLA2) across NES Patches B1 and A1 (refer to:

<http://prdapp008/app/flex/heritageaudit/index.html>)

Visitor and Community Awareness

Recreation activities

Only passive recreation is permitted in Kama.

Pets are not permitted in the reserve.

Reserve access

Entrances to the reserve are from William Hovell Drive (from an underpass on the northern side and a track on the southern side of William Hovell Drive) and from Pipeline Road north of the Molonglo River corridor.

The reserve is designated dog-free and suburbs to be developed to the east of the reserve will be declared cat containment areas. Horses are not permitted within the reserve.

Interpretation and information

There are information signs at the entrance of the reserve above William Hovell Drive and there is a sign-posted interpretation walk through the reserve (Figure 3).

Key Stakeholders

Community involvement

PCS will consult and engage with community groups to assist and implement conservation management works within Kama.

Canberra Ornithologists Group

- Woodland bird monitoring (Figure 7) (www.canberrabirds.org.au)

Bush on the Boundary Molonglo

Bush on the Boundary groups consist of various Government and non-governmental stakeholder groups with an interest in the urban edge. BoB Molonglo was established in 2011 and is managed by the Molonglo Catchment Group. BoB Molonglo is focussed on the new urban development of Molonglo.

Land management, monitoring and research

Parks and Conservation Service (TAMS)

- Land management
- NES vegetation and habitat condition monitoring (locations on Figure 7)
- Woodland Restoration Program
- Ecological Fire management

Conservation Planning and Research (EPD)

- Implementation of Action Plans for Natural Temperate Grassland, Box-Gum Woodland, Pink-tailed Worm-lizard and Superb Parrot
- Biomass and floristic diversity monitoring (Figure 7)
- Kangaroo population dynamics
- Grassland vegetation diversity monitoring program (Figure 7)
- Reptile monitoring plots (Figure 7)

Australian National University

- Research on revegetation techniques and improving forb diversity (Figure 7; David Johnson, Fenner School, ANU: david.johnson@anu.edu.au)

Rural neighbours

- Western border (Rural lease – 99 year lease signed in 2010): Mr AT & Mrs MJ Wallace (ph: 02 6291 3494; mob: 0412 510 255)
- Eastern border (Grazing licence): Mr Renato Gaspari (ph: 02 62275694; mob: 0408 023 789)

Infrastructure

ACTEW

- Powerline maintenance (Figure 3; ph: 13 21 93)
- Sewer access along Pipeline Road (Figure 3)
- Maintenance of roadsides on Pipeline Road

TAMS

- Maintenance of William Hovell Drive roadside

Management Objectives

The draft statutory Reserve Management Plan identifies the following objectives relevant to Kama:

GEOLOGY, LANDFORMS, SCENERY AND SOILS

C. Ensure that no land remains close to or below a critical threshold for landscape function in the long term.

D. People are able to access, view and enjoy a diversity of scenery that is dominated within the Reserve by natural features.

ECOLOGICAL CONSERVATION

E. The population size of threatened species increases and the extent of listed dryland threatened communities is at least maintained and their condition improved.

F. Maintain the diversity of all other native species and improve the ecological condition of the dryland matrix.

H. Manage vegetation to achieve fire protection for people and property and effective protection of threatened habitat and other ecological conservation values.

I. Improve connectivity within and outwards from the Reserve.

ABORIGINAL CONNECTIONS

J. Respect, promote and protect Aboriginal use, past and current, of the land and waters of the Lower Molonglo River.

SETTLEMENT HISTORY

K. Protect, promote and respect the European cultural heritage in the Reserve.

RECREATION

M. Residents in Molonglo view, treat and protect the Reserve as their 'treasured front yard' and set a new high standard in the ACT for their behaviour in a nature reserve.

INFRASTRUCTURE AND OPERATIONS

O. Avoid or minimise the impact on Reserve values of building and maintaining infrastructure and facilities in or nearby the Reserve.

P. Minimise harm to people and the environment from Reserve operations.

The NES Plan

Management of Kama is to be implemented in accordance with the requirements of the *Molonglo Valley Plan for the Protection of Matters of National Environmental Significance* (NES Plan; ACTPLA 2011) and the Molonglo Adaptive Management Strategy (TAMS 2013). The NES plan identifies that conservation activities are based around two processes: avoidance and mitigation of impacts on Matters of National Environmental Significance (MNES); and on-ground management to provide maintenance and improvement of MNES values.

The Operational Plan is the day-to-day management planning tool that provides detail about on-ground works and activities and will be the primary mechanism for providing for adaptive management approaches based on the results of monitoring, evaluation and review. Operational Plans should be read together with the *Molonglo Ecological Management Guidelines* (TAMS in prep).

A *Monitoring Procedures Manual* (Sharp and Milner 2014) has also been prepared for the Molonglo. The manual provides a step by step guide to ongoing vegetation and habitat condition monitoring in the Molonglo.

The objectives are consistent with requirements for management of Kama as an offset site as defined in the NES Plan (ACTPLA 2011), as follows:

Develop a management plan for Kama Nature Reserve (*note: this requirement has been fulfilled through the development of this plan and the development of the Molonglo River Reserve and Offset Areas Ecological Management Guidelines*) to provide for the maintenance and enhancement of the ecological condition of:

- Box-Gum Woodland within the reserve (NES Action 5).
- Natural Temperate Grassland within the reserve (NES Action 25).
- All Pink-tailed Worm-lizard habitat within the reserve (NES Action 32).

Implement the management plan for the Kama Nature Reserve to provide for the maintenance and enhancement of the ecological condition of:

- Box-Gum Woodland within the reserve (NES Action 6).
- Natural Temperate Grassland within the reserve (NES Action 26).
- All Pink-tailed Worm-lizard habitat within the reserve (NES Action 33).

Establish a buffer outside the Kama Nature Reserve between the reserve and the proposed development area, and allow for appropriate uses consistent with nature conservation uses of the reserve. The buffer will be developed to ensure that fire management is undertaken outside of the Kama Nature Reserve³ and will provide protection against urban edge effects (NES Actions 7, 27, 34).

Pp 37-38, NES Plan: The management plan for Kama is to incorporate:

- Protection of MNES values.
- 20 m buffers for high and moderate quality Pink-tailed Worm-lizard habitat.
- Appropriate ecological fire management and biomass control to achieve/maintain environmental condition targets.
- Control of access to achieve/maintain environmental condition targets.
- Weed management, priority given to reducing weed species that have the greatest adverse ecological impact.
- Feral animal management to avoid native animal predation and rabbit grazing.
- Management of hydrological processes.
- Restoration of the ecological attributes lost within the lower Molonglo Valley
- Appropriate condition monitoring against the objectives for management.

³ The ACT Government is seeking acceptance of a deviation of the NES Plan from the Commonwealth for proposed fire management in Kama.

Management Challenges and Principles for Kama

Challenges	Principles (from the 'Molonglo Ecological Management Guidelines')
1. Biomass management	<ul style="list-style-type: none"> • Biomass management will include planned burns⁴, strategic grazing⁵ and selective slashing (mostly along management tracks and around the boundary) to maintain diversity of structure, habitat and composition for threatened species and communities. Particular guidelines include: <ul style="list-style-type: none"> ○ Maintain biomass within NTG and BGW between 1.5-4 t/ha on average measured in autumn. ○ Biomass removal should not be undertaken if the biomass level is below 1.5 t/ha. ○ Maintain approximately 70% groundcover to minimise erosion but still retain open spaces to allow for recruitment of forbs and other non-dominant species. ○ Impacts of rabbits, grazing by livestock or other fire fuel management actions will be addressed before consideration is given to controlling kangaroo abundance. ○ Undertake burns no more frequently than ten years apart in woodlands, three to five years apart in high quality grasslands and five years apart in Pink-tailed Worm-lizard habitat, or according to the <i>Ecological Guidelines for Fuel and Fire Management Operations</i> if these are modified. ○ Burn in mosaics with no area burnt more frequently than the ecological fire threshold allows and no more than 25% of a patch at one time. Mosaic burns will aim to promote ecological diversity through creating a network of different post fire patches and habitat types (incl. open grassy patches and dense mid-storey patches important to woodland birds). Undertake low intensity patchy burns resulting in low impacts on woody vegetation. ○ Maintain a buffer of at least 20 m around Pink-tailed Worm-lizard habitat during control burns if undertaken outside the recommended fire frequency. ○ In high conservation value areas (NES Patch A and B): avoid burning during spring to minimise interruption to plant regeneration processes and nesting birds. ○ In low diversity native pasture: burn between 1-3 years apart from mid August to end of October to reduce exotic annuals. ○ Minimize ignition of woody debris in woodland areas by only burning in winter. ○ Rakehoe around hollow bearing trees (potential Superb Parrot nesting sites) or otherwise protect hollow-bearing trees during burn operations. ○ Utilise stock grazing only if the grazing will enhance habitat and species diversity and if other methods of biomass management are not appropriate or possible. ○ In high conservation value areas (NES Patch A and B): graze at high intensity for short periods between late summer and early winter, to reduce opportunity to selectively graze disturbance sensitive species. ○ In low diversity native pastures: graze at high intensity for short periods between mid August to the end of October to reduce exotic annuals. Current research indicates levels of 4 – 6 dse in moderate to good seasonal conditions will reduce biomass and maintain habitat condition. ○ Slash at a minimum height of 100 mm along tracks and boundaries for visibility and provision of a fire break. ○ Remove clippings if they are likely to smother established plants. ○ Use a hand-held brush-cutter if required to reduce biomass in rocky areas including

⁴ Planned burns may include burns undertaken solely for ecological purposes, or burns for wildfire mitigation where these are not in conflict with meeting ecological outcomes.

⁵ Strategic grazing will include consideration of the advantages and disadvantages of all forms of biomass removal (see Sharp et al., in prep.), levels of biomass, restrictions on the use of planned burns, frequency, intensity and timing of grazing.

	Pink-tailed Worm-lizard habitat.
2. Fire fuel mitigation and wildfire suppression	<ul style="list-style-type: none"> Bushfire Operation Planning (BOP) activities must be conducted in accordance with the <i>Ecological Guidelines for Fuel and Fire Management Operations</i>, the <i>Molonglo River Reserve and Offset Area Ecological Management Guidelines</i>, the <i>Molonglo Development Fire Management Strategy</i>, the <i>Strategic Bushfire Management Plan</i> and Management Principles identified within Challenge 1 (Biomass Management). A buffer will be established between the Reserve and the proposed development area to provide for fire management activities (i.e. Asset Protection Zones), that may be detrimental to the threatened species and communities if undertaken within Kama (NES Plan Actions 7, 27 and 34). Avoid (if possible) fire suppression activities that may impact habitat within Kama (i.e. the use of earth moving equipment to construct fire control lines). Chemical fire retardant, fire fighting foam or wetting agents will not be used in the reserve. Bark of Red Stringybark (<i>Eucalyptus macrorhyncha</i>) trees may be charred, using a tree by tree approach, to a height of <5m. Stringybark trunks are a foraging resource for numerous woodland bird species (incl. Brown Treecreepers) and therefore any scorching of bark should be kept to a minimum. Where required, restoration plantings may have low branches pruned below 2m. Pruning to 2m of natural regeneration will only be allowed in areas of BGW where native mid storey cover exceeds 12.5% measured at a patch level (i.e. NES patches B1, B2, B3 and O1; NB: BGW benchmark value for native mid storey cover is 0-12.5%). The occurrence of high biomass grassy weeds such as Wild Oats, Phalaris, Cocksfoot and Fescue will be controlled using ecological burns, strategic grazing and herbicide application.
3. Enhancement of habitat values	<ul style="list-style-type: none"> Areas dominated by weeds may require long-term strategic control involving reduction in nutrient levels, removal of weeds, control of secondary weed invasion, revegetation and enhancement of other habitat attributes. Restoration through enhancement of habitat attributes such as logs and rocks may be appropriate. Enhancement of habitat to improve connectivity between Kama and the Molonglo River will take into account Natural Temperate Grassland and PTWL habitat. Restoration plantings will not include the use of Red stringybark eucalypts (<i>Eucalyptus macrorhyncha</i>) Restoration plantings and re-stocking of the canopy trees should be undertaken in clumps and staged so that the plants can most easily be protected from the affects of ecological burning and/or grazing.
4. Invasive plants	<ul style="list-style-type: none"> St John's Wort is abundant and widespread. Paterson's Curse and Blackberry are common and widespread. African Lovegrass is occasional and localised. With increased visitation weeds such as Chilean Needlegrass, Fireweed and Serrated Tussock may invade. Wild Oats is abundant in Patch O. Maintaining a low cover and localized distribution of these weeds is a priority. African Lovegrass invasion poses a significant ecological and fire hazard threat to the reserve. Existing incursions to be removed and new incursions to be treated immediately and soil disturbance minimised to reduce potential for invasion. The occurrence of high biomass grassy weeds such as Phalaris, Cocksfoot and Fescue will be controlled using ecological burns, strategic grazing and herbicide application. Weedy patches, mainly dominated by introduced annuals, exist throughout the reserve and will be subject to weed control and restoration. In woodland areas woody weeds may be providing habitat for declining woodland birds.

	<p>Phased woody weed control and a mid-storey shrub regeneration or replacement program will reduce impacts on the bird community.</p> <ul style="list-style-type: none"> • Woody weeds, incl. Blackberry, will be controlled using ecological burns, strategic grazing and herbicide application. • Weed management programs should consider the use of multiple control techniques (incl. herbicide application, manual removal, shading, strategic grazing, ecological burns, nutrient manipulation etc). • The buffer to the east of Kama must provide protection against urban edge effects, including weed invasion.
5. Invasive animals	<ul style="list-style-type: none"> • Rabbit abundance is low. Deer have been observed in Kama in low numbers and feral goats and pigs have been observed in the neighbouring lower Molonglo River corridor. Feral rabbits, deer, goats and pigs threaten flora and fauna habitat and may also compete with native fauna for resources. Feral cats are likely to occur in the reserve. • Predation by foxes and cats pose a significant threat to threatened and declining woodland birds and to threatened lizard and grasshopper species. • Pest animal issues from uncontained suburban pets may become an issue within the Reserve as suburbs are developed to the east of the reserve. • Indian Mynas and other invasive introduced birds may impact native species and habitat as urban development builds up adjacent to the Park. • Options for a co-ordinated control program with neighbouring landholders require investigation to identify best practice methods for landscape scale control to benefit native fauna. • Kangaroo populations were controlled in 2013. • Neighbouring suburbs to be cat containment areas. • The reserve is a dog-free area. • Pest management programs should consider the use of multiple control techniques (incl. baiting, trapping, fumigation, shooting, exclosure fencing etc). The use of Pindone is not recommended due to the risk of secondary poisoning to Little Eagles. • The development of nearby urban areas may lead to increases in bird species such as the Indian Myna and rosella that compete with the Superb Parrot for nesting hollows. Superb Parrot breeding and increases in populations of competitors should be monitored and if required control action for these species undertaken. • The buffer to the east of Kama must reduce urban edge effects, including pressures from native and non-native pest and domestic animals (e.g. cats, dogs, Indian Mynas, Noisy Miners, Currawongs etc).
6. Infrastructure: vehicles and track maintenance	<ul style="list-style-type: none"> • Strict vehicle hygiene should be observed at all times, as the threat of potential weed incursion from utility, contractor and authorised vehicles are very high. • All vehicle access (including quad bikes) is to be excluded from Pink-tailed Worm-lizard habitat areas and managed in other areas to avoid soil compaction. • Only low-impact vehicles, such as quad bikes, should be used to undertake management activities off the management trail network. • There are formal management tracks and trails that require cyclical maintenance and erosion control. The ACT Government is currently investigating the appropriate location for additional mineral earth fire trails outside the reserve. • Illegal vehicle access should be monitored and procedures put in place to reduce unauthorized access.
7. Infrastructure: utility	<ul style="list-style-type: none"> • ACTEW currently maintains power lines through the Box-Gum Woodland community. Maintenance should be undertaken within best-practice guidelines and in accordance with the code of practice.
8. Adjacent roads, urban	<ul style="list-style-type: none"> • Weed incursions from vehicle access and increased recreational access may be a source of weed seeds.

areas and rural leases	<ul style="list-style-type: none"> • The rural area to the west may be a source of weed invasion. • The buffer to the east of Kama must provide protection against urban edge effects and be compatible with fire fuel management activities.
9. Visitor and community awareness	<ul style="list-style-type: none"> • Access to the Kama is limited to the William Hovell Drive entrances. Currently there is limited access off Pipeline Road, which is only accessible by foot or bicycle as the road is closed off from public access. • Passive recreational pursuits are undertaken on the reserve, generally only by dedicated naturalists with particular interest in the reserve. • Walking tracks to be excluded from Pink-tailed Worm-lizard habitat areas • Dogs are not permitted in the reserve. • There may be a significant increase in visitation and subsequent pressures once residential areas in the vicinity of the reserve are established. • As the suburbs are developed, illegal entry of dogs into the reserve may become an issue. • Kama may be subject to firewood or rock collection. • Rock-rolling or other PTWL habitat disturbance may be an issue as recreation increases. • The ecological values and user restrictions of the Reserve are identified on a series of interpretative signs within the reserve on the main entrance track off William Hovell Drive.
10. Scientific studies	<ul style="list-style-type: none"> • There are existing and potential scientific studies within Kama (Figure 7), including: <ul style="list-style-type: none"> ○ Revegetation of herbaceous species (ANU Fenner School). ○ Woodland bird monitoring (COG). ○ Impacts of biomass on kangaroos, vegetation and other fauna (CPR).
11. Community Engagement	<ul style="list-style-type: none"> • There is no ParkCare group associated with Kama Nature Reserve. As residential areas are developed in the vicinity of the reserve, consideration should be given to establish and appropriately resource a ParkCare group. • Community engagement is limited to specific identified opportunities for volunteers and small-scale, passive, low-impact recreation. • Canberra Ornithologists Group undertake regular woodland bird monitoring in the site.
12. Documentation	<ul style="list-style-type: none"> • Documentation of the reserve values need to be provided to all stakeholders to facilitate appropriate visitor behavior. • Documentation of the attributes and records of actions, activities, research and maintenance are required to implement adaptive management. • Monitoring results need to be collated and reviewed. • Report on all activities within the annual NES Plan report.

Management Actions

Refer to the management principles above and the *Molonglo Ecological Management Guidelines* (TAMS in prep.).

Strategies	Actions	Who	Source
1. Manage biomass to maintain optimal structure and diversity	<p>1.1 Develop a biomass management program that may include burning, slashing and stock grazing and that takes into account kangaroo grazing pressure.</p> <p>1.1.1 Consider conditions (timing, seasonal constraints and specific requirements of threatened species and communities) under which biomass management is implemented.</p> <p>1.1.2 Collate and map existing information on location of weed patches, location of rare species, potential Superb Parrot habitat trees and other site attributes (e.g. gates, fences, dams).</p> <p>1.1.3 Review monitoring results, effectiveness of previous management strategies and Biodiversity Triage Matrix to identify strategies and priorities for the forthcoming year.</p> <p>1.1.4 Identify, map and monitor condition of areas that are under pressure from kangaroo grazing and camping.</p> <p>1.1.5 Liaise with relevant agencies and organisations, including the Vertebrate Pest Officer (in regard to kangaroo population control), Rural Programs Officer, Fire Management Officer, Environmental Weeds Officer, CPR and external research organisations undertaking studies in Kama in development of the program.</p> <p>1.1.6 Identify appropriate areas, timing, intensity, density and type of stock that can be used if grazing is to be applied.</p>	Kama Ranger, Ecologist, CPR	NESrec, CNPrec
	<p>1.2 Implement the integrated biomass management program.</p> <p>1.2.1 Undertake planned management according to the biomass management program (including the implementation of the Kangaroo management program as required).</p> <p>1.2.2 Undertake regular inspections to ensure there is no damage to vegetation and Pink-tailed Worm-lizard habitat. If impacts are detected undertake immediate reparation work to improve condition before effects of impacts become major.</p> <p>1.2.3 Monitor biomass levels to determine whether biomass reduction activities should be applied.</p>	Kama Ranger, GSO, Ecologist, FMU, Rural landholder Contractor	Mrec, Mcw, NESrec, NEScw, FMU, CNPrec
	<p>1.3 Monitor the integrated biomass management program.</p> <p>1.3.1 Monitor change in condition based on benchmark attributes: plant species diversity, cover and habitat diversity and targeted monitoring of Pink-tailed Worm-lizard, Superb Parrot and declining woodland bird populations and habitat (see <i>Monitoring Procedures Manual for Molonglo Offset Areas</i>).</p> <p>1.3.2 Monitor biomass annually in autumn to guide biomass management actions required in the forthcoming year.</p> <p>1.3.3 Monitor grazing impacts by kangaroos to determine impacts on biomass and species diversity.</p> <p>1.3.4 Review the program after five years or when scientific</p>	Kama Ranger, Ecologist	NESrec, CNPrec

	research and/or monitoring results indicate that the objectives of this plan are not being met through the biomass management program.		
2. Minimise the impacts of wildfire	<p>2.1 Co-ordinate, in accordance with the Regional Fire Management Plan (RFMP) and the Molonglo Development Fire Management Strategy, an integrated fuel management program for the ecological and cultural heritage assets.</p> <p>2.1.1 Manage fire and fuel to protect and enhance the Reserve's ecological values, considering the protection of habitat features, key connectivity corridors, control of herbaceous biomass, promotion and protection of natural regeneration, habitat diversity, fire thresholds for species and communities and post-fire weed control.</p> <p>2.1.2 Meet with the Fire Management Officer to discuss district requirements for BOP and finalise budget for forthcoming year.</p>	Kama Ranger, Ecologist, FMU	NESrec, FMU, CNPrec
	<p>2.2 Implement the integrated mosaic fuel management program for the ecological and cultural heritage assets.</p> <p>2.2.1 Undertake fuel management inside the reserve if it will achieve ecological outcomes as defined in the objectives and above management principles.</p> <p>2.2.2 Maintain and slash existing boundary tracks and trails within the reserve that are wide enough to support fire trucks.</p> <p>2.2.3 Investigate the appropriate positioning of new mineral earth fire trails outside the reserve.</p>	Kama Ranger, GSO, Ecologist, FMU, Rural landholder Contractor	Mrec, Mcw, NESrec, NEScw, FMU, CNPrec
	<p>2.3 Monitor the fuel management program against condition of the ecological and cultural heritage assets (see <i>Monitoring Procedures Manual for Molonglo Offset Areas</i>).</p> <p>2.3.1 Use the results of the condition monitoring program to determine whether fire fuel management is impacting threatened species and communities and modify it if required.</p>	Kama Ranger, Ecologist	NESrec, CNPrec
3. Enhance habitat values	<p>3.1 Develop a restoration program for the reserve, with priority to areas where weed control may result in bare ground and/or reinvasion by weeds.</p> <p>3.1.1 Identify and map areas where enhancement of habitat is required.</p> <p>3.1.2 Investigate how to reduce annual introduced species in Patch O and reduce likely high nutrient levels, and restore using indigenous woodland species.</p> <p>3.1.3 Identify weedy patches in Patches A and B and determine if they should be replanted with indigenous grassland or woodland species, as appropriate.</p> <p>3.1.4 Assess whether nesting boxes should be installed where hollow bearing trees are rare.</p> <p>3.1.5 Develop a restoration program to improve connectivity between Kama and Molonglo River without compromising Pink-tailed Worm-lizard habitat or wildfire mitigation or sites of Aboriginal significance.</p> <p>3.1.6 Liaise with government ecologist (CPR)</p>	Kama Ranger, Ecologist, CPR	NESrec, CNPrec

	<p>3.2 Implement the restoration program.</p> <p>3.2.1 Undertake regular inspections to ensure there is no damage to vegetation, Pink-tailed Worm-lizard habitat and sites of Aboriginal significance. If impacts are detected undertake immediate reparation work to improve condition before effects of impacts become major.</p> <p>3.2.2 Enhance habitat diversity through restoration of fallen timber, hollows, rocks and structural diversity of the vegetation, utilising materials from developed areas where appropriate.</p> <p>3.2.3 Revegetate areas left bare from weed control.</p> <p>3.2.4 Undertake a revegetation program in Patch O in conjunction with a weed control program.</p> <p>3.2.5 Do not plant tall shrubs and trees within 20 m of Pink-tailed Worm-lizard habitat or within the Natural Temperate Grassland in Patch A or between Patch A and the Molonglo River corridor.</p> <p>3.2.6 Timber removal for power line maintenance to be retained as coarse woody debris within the woodlands.</p> <p>3.2.7 Undertake immediate remediation works and site rehabilitation if habitat has been disturbed.</p> <p>3.2.8 Adapt restoration effort in line with guidance from research projects undertaken within or which are relevant to Kama</p>	Kama Ranger, Ecologist, Contractor	Mrec, MCW, NESrec, NEScw, CNPrec
	<p>3.3 Monitor the restoration program (see <i>Monitoring Procedures Manual for Molonglo Offset Areas</i>).</p> <p>3.3.1 Monitor the success of revegetation to determine whether appropriate species have been used and whether follow-up planting is required.</p> <p>3.3.2 Monitor whether there has been any change in utilisation of habitat resulting from revegetation, especially bird abundance and/or diversity.</p>	Kama Ranger, Ecologist	NESrec, CNPrec
4. Reduce the impact of invasive plants	<p>4.1 Develop an integrated weed management program for the Reserve.</p> <p>4.1.1 Map the distribution of environmental weeds.</p> <p>4.1.2 Review monitoring results, effectiveness of previous management strategies, Weed Management Priorities Table and Biodiversity Triage Matrix to identify strategies and priorities for the forthcoming year.</p> <p>4.1.3 Meet with Environmental Weeds Officer to discuss district requirements for EWOP and finalise budget for forthcoming year.</p> <p>4.1.4 Engage Reserve stakeholders and coordinate with neighbours in the planning and implementation of upcoming control programs.</p> <p>4.1.5 Prioritise treatment of invasive weeds at reserve entry points, along management tracks and walking trails and within infrastructure easements.</p> <p>4.1.6 Prevent the incursion of new pest plants through the strategic placement and design of park developments, visitor management, fencing, surveillance, staff training, community education and rapid response following reports of new pest</p>	Kama Ranger	CNPrec

	plants.		
	<p>4.2 Implement an integrated weed management program.</p> <p>4.2.1 In Pink-tailed Worm-lizard habitat only undertake species specific spot spraying and cut/paint methods for shrubs and trees.</p> <p>4.2.2 Undertake in-house control and map areas controlled.</p> <p>4.2.3 Undertake field contract supervision and map areas controlled.</p> <p>4.2.4 Review the effectiveness of the program and identify follow-up actions.</p> <p>4.2.5 Undertake follow-up actions.</p> <p>4.2.6 Undertake site rehabilitation.</p> <p>4.2.7 Coordinate volunteers to assist with control, follow up and site rehabilitation.</p> <p>4.2.8 Maintain and monitor vehicle hygiene by ensuring vehicles are clean of mud, soil, dry vegetation or seeds to limit the spread of weeds.</p>	Kama Ranger, GSO, Contractor	Mrec, Mcw, NEScw, NESrec, CNPrec
	<p>4.3 Monitor the distribution and abundance of environmental weeds within the reserve.</p> <p>4.3.1 During routine patrols, collect data on distribution and abundance of environmental weeds.</p> <p>4.3.2 Undertake pre-treatment distribution mapping.</p> <p>4.3.3 Undertake post-treatment distribution mapping.</p> <p>4.3.4 Coordinate volunteers to assist with data collection.</p> <p>4.3.5 Record all mapping data in the Reserve Weed Management folder on ArcGIS.</p> <p>4.3.6 Monitor weed control to identify whether there has been a change in native plant diversity as a result of weed control.</p> <p>4.3.7 Involve stakeholders in the monitoring program.</p> <p>4.3.8 Monitor bird species abundance to determine if they have been impacted by removal of woody weeds.</p>	Kama Ranger, GSO, Ecologist	NESrec, CNPrec
5. Reduce the impact of invasive animals	<p>5.1 Develop an integrated pest animal management program for the Reserve.</p> <p>5.1.1 Map the distribution of damage and/or habitat of pest animals.</p> <p>5.1.2 Review monitoring results, effectiveness of previous management strategies, Invasive Animal Management Priorities Table and Biodiversity Triage Matrix to identify strategies and priorities for the forthcoming year.</p> <p>5.1.4 Utilise methods that minimise soil disturbance, particularly in Pink-tailed Worm-lizard habitat and sites of Aboriginal significance.</p> <p>5.1.5 Engage reserve stakeholders and coordinate with neighbours in the planning and implementation of upcoming control programs.</p>	Kama Ranger,	CNPrec
	<p>5.2 Implement an integrated pest animal management program.</p> <p>5.2.1 Undertake in-house control and map and report on results.</p>	Kama Ranger,	Mrec, Mcw,

	<p>5.2.2 Undertake field contract supervision and map and report on results.</p> <p>5.2.3 Undertake follow-up actions.</p> <p>5.2.4 Undertake site rehabilitation.</p> <p>5.2.5 Coordinate volunteers to assist with control, follow up and site rehabilitation.</p> <p>5.2.6 Enforce responsible pet ownership (no dogs and containment of domestic cats in neighbouring areas).</p>	GSO, Contractor	NEScw, NESrec, CNPrec
	<p>5.3 Monitor the distribution and abundance of pest animals within the reserve.</p> <p>5.3.1 Undertake pre-treatment distribution mapping.</p> <p>5.3.2 Undertake post-treatment distribution mapping.</p> <p>5.3.3 Coordinate volunteers to assist with data collection.</p> <p>5.3.4 Record all mapping data in the Reserve Pest Species Management folder on ArcGIS.</p> <p>5.3.5 Engage stakeholders in the monitoring program.</p> <p>5.3.6 Review the effectiveness of the program and identify follow-up actions.</p>	Kama Ranger, GSO	CNPrec
6. Control vehicle movement and impacts	<p>6.1 Ensure all stakeholders entering the site comply with strict hygiene requirements, including ensuring vehicles are clean before entering the site to reduce the threat of weed introduction and spread.</p> <p>6.2 Inform all stakeholders to remain on authorised tracks only.</p> <p>6.3 Identify and undertake any specific trail maintenance requirements.</p> <p>6.4 During routine inspections monitor for illegal access and the establishment of any unauthorised tracks.</p> <p>6.5 Use only low impact vehicles (e.g. quad bikes) for off-track access.</p> <p>6.6 Maintain vehicle tracks and associated infrastructure.</p> <p>6.7 Limit vehicle access when soil is moist or wet.</p> <p>6.8 Avoid off-track access when weeds are seeding to minimise weed spread.</p> <p>6.9 Slash no lower than 100 mm using a flail mower along designated tracks and fire trails.</p>	Kama Ranger, GSO	CNPrec
7. Reduce impacts of management of utility infrastructure	<p>7.1 Infrastructure maintenance for existing infrastructure should be undertaken within best-practice guidelines for endangered species and communities.</p>	Kama Ranger, D&D, Ecologist	NESrec, CNPrec
	<p>7.2 No new infrastructure that is likely to reduce ecological integrity of the reserve is to be developed.</p>	Kama Ranger, CPR, D&D, Ecologist	NESrec, CNPrec
	<p>7.3 Manage infrastructure-related disturbance through the licensing and approvals process.</p>	CNP (nth) Ranger in	NESrec, CNPrec

	7.3.1 Licensed works must adhere to the code of practice. 7.3.2 Under the <i>Planning and Development Act 2007</i> , an Environmental Impact Statement (EIS) may be required for any works that could impact the soil, vegetation or threatened species.	Charge, CPR, Ecologist, TAMS licensing	
	7.4 Undertake site inductions for all personnel working within the reserve to identify values and their specific management requirements. 7.5 Supervise infrastructure-related works and site rehabilitation closely during implementation. 7.6 Monitor infrastructure-related disturbance after completion and ensure follow-up rehabilitation is undertaken if required.	Kama Ranger, D&D, Ecologist	NESrec, CNPrec
	7.7 When providing conditions of approval – ensure conditions are unambiguous and prescriptive e.g. rehabilitate site with 1g native seed mix per sq m) and ensure >80% ground cover before handover.	CNP (nth) Ranger in Charge, Kama Ranger	CNPrec
8. Ensure activities in adjacent land does not impact the reserve	8.1 Liaise with organisations, businesses and lessees responsible for land management in areas adjacent to the reserve. 8.2 Participate in the planning and development process for works on land adjacent to the reserve. 8.3 Monitor works, landscaping and land management activities on adjacent land to ensure the values of the reserve will not be impacted.	Kama Ranger	CNPrec
	8.4 Ensure that the buffer to the east of Kama is of sufficient width to provide protection against urban edge effects.	D&D, Ecologist, CPR	NESrec,
9. Enhance visitor and community awareness	9.1 Manage organised recreational activities. 9.1.1 Review the nature and scale of recreational activities that are compatible with maintaining the values of the reserve. 9.1.2 Provide information to users and inform all stakeholders to remain on authorised tracks only. 9.1.3 Maintain recreation tracks and associated infrastructure. 9.1.4 Supervise recreation activities. 9.1.5 Monitor organised recreation events and ensure conditions are adhered to and provide feedback to users and others. 9.1.6 Maintain reserve security to prevent accidental or malicious damage to infrastructure, Aboriginal, European and natural values. 9.1.7 Use the review of compatible recreation activities to guide good visitor behaviour.	Kama Ranger	CNPrec
	9.2 Promote awareness of values to visitors and other stakeholders 9.2.1 Publish and promote profiles of the ecological and other values in the reserve. 9.2.2 Maintain and update interpretive signage. 9.2.3 Provide updated information about the Reserve on signage and websites and in written form. 9.2.4 Seek direct contact with Reserve users. 9.2.5 Facilitate and undertake guided walks, community and	Kama Ranger, Ecologist, D&D	Mrec, Mcw, NESrec, NEScw, CNPrec

	<p>school talks.</p> <p>9.2.6 Undertake site inductions for all personnel or organisations undertaking organised activities within the reserve to identify values and their specific management requirements.</p>		
10. Encourage and support scientific studies	<p>10.1 Maintain links with existing and potential research organisations.</p> <p>10.1.1 Consult Conservation Planning and Research (EPD) in relation to any changed management activities in Pink-tailed Worm-lizard and Superb Parrot habitat</p> <p>10.2 Maintain a library of research and monitoring relevant to the reserve, including contacts, specific requirements, maps of locations and reports and papers.</p>	Ecologist	NESrec
	<p>10.3 Facilitate the planning, coordination and implementation of research projects.</p> <p>10.3.1 Encourage and support scientific studies that aim to enhance the protection of MNES and other significant flora, fauna communities.</p> <p>10.3.2 Identify opportunities for research and monitoring programs that evaluate the effectiveness of management practices in situ.</p> <p>10.4 Review the implications of research and monitoring results for management.</p>	CNP (nth) Ranger in Charge, Kama Ranger, Ecologist	Mrec, NESrec, CNPre
11. Encourage and support community engagement	<p>11.1 Develop a volunteer program</p> <p>11.1.1 Maintain a list of volunteers who wish to be involved in projects</p> <p>11.1.2 Identify works projects suitable for volunteers.</p>	Kama Ranger, Parkcare Support Officer	CNPre
	<p>11.2 Support and encourage CVA and other volunteers to participate in the conservation of the ecological and cultural heritage values of the Reserve</p> <p>11.2.1 Co-ordinate and supervise volunteers while undertaking work in the reserve.</p>	Kama Ranger, Ecologist	NESrec, CNPre
	<p>11.3 Consider establishing, guiding and resourcing a ParkCare group once there are enough volunteers willing to assist in a ParkCare group.</p> <p>11.3.1 Liaise with the PCS ParkCare support officer.</p>	Kama Ranger, Parkcare Support Officer	CNPre
12. Document values	<p>12.1 Maintain records of actions undertaken and other relevant information</p> <p>12.1.1 Maintain a comprehensive database of the ecological and cultural heritage values of the Reserve.</p> <p>12.1.2 Provide annual reports on management implementation.</p> <p>12.1.3 Update wildlife atlas records and vegetation database with data on rare species</p>	Kama Ranger, D&D, Ecologist	NESrec, CNPre

	<p>12.2 Maintain and promote monitoring programs.</p> <p>12.2.1 Undertake annual monitoring of vegetation condition, bird diversity, Superb Parrot and Pink-tailed Worm-lizard, impacts of weed control on the native diversity and revegetation success.</p> <p>12.2.2 Review monitoring results annually for identification of issues that require short-term management.</p> <p>12.2.3 Analyse monitoring results and provide reports every five years and consider implications for management.</p> <p>12.2.4 Assist with the coordination and implementation of CPR and COG monitoring programs.</p> <p>12.2.5 Promote and assist with monitoring of other species within Kama.</p>	Kama Ranger, Ecologist	NESrec, CNPrec
	<p>12.3 Provide report on activities to the NES Plan Co-ordinator for inclusion in the Annual Report.</p>	D&D, Kama Ranger, Ecologist	NESrec, NEScw, CNPrec

Maps⁶

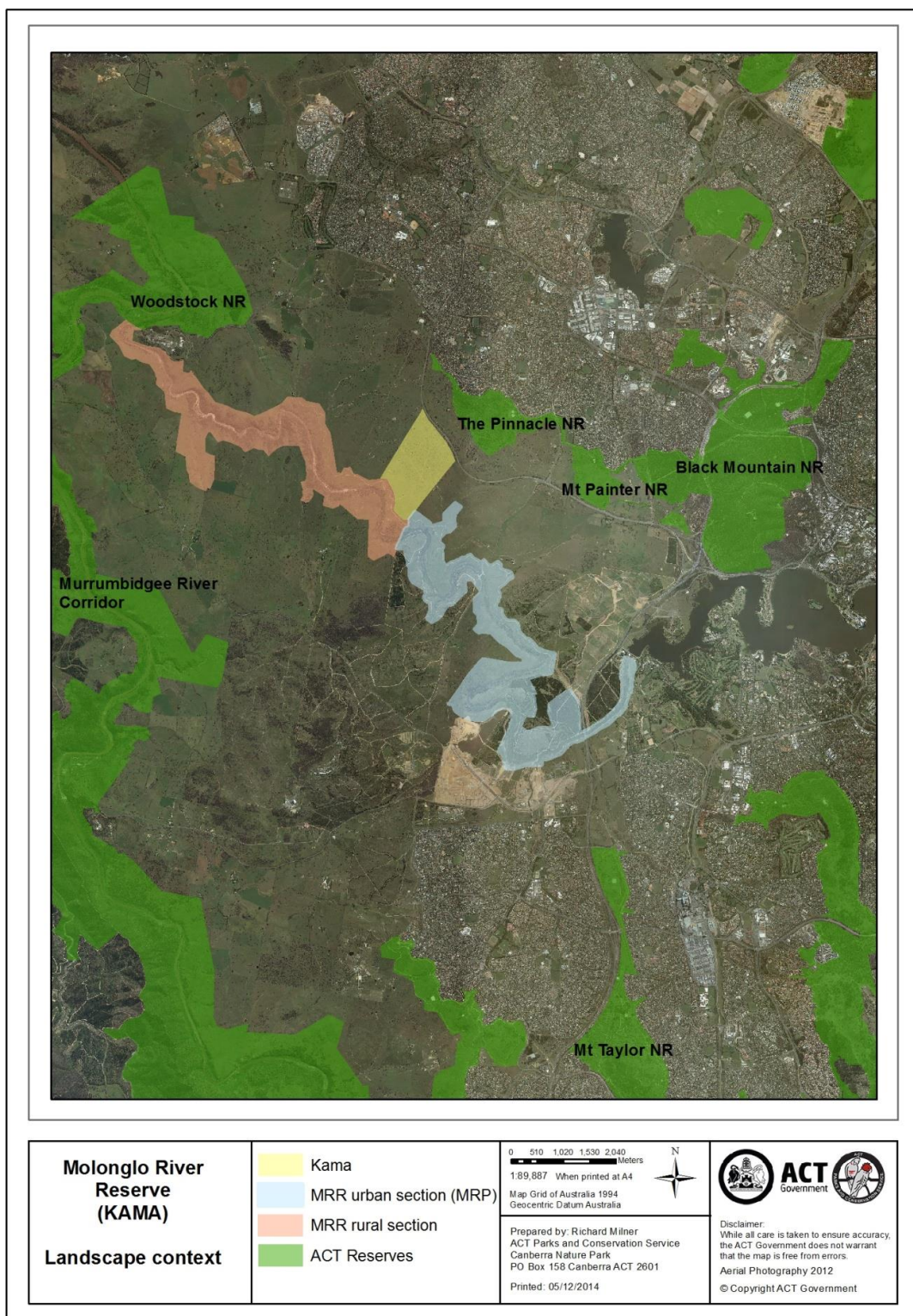


Figure 1. Kama landscape context.

⁶ Information provided in the following maps may change as more information becomes available. Users should refer to (insert hyperlink) for current spatial data.

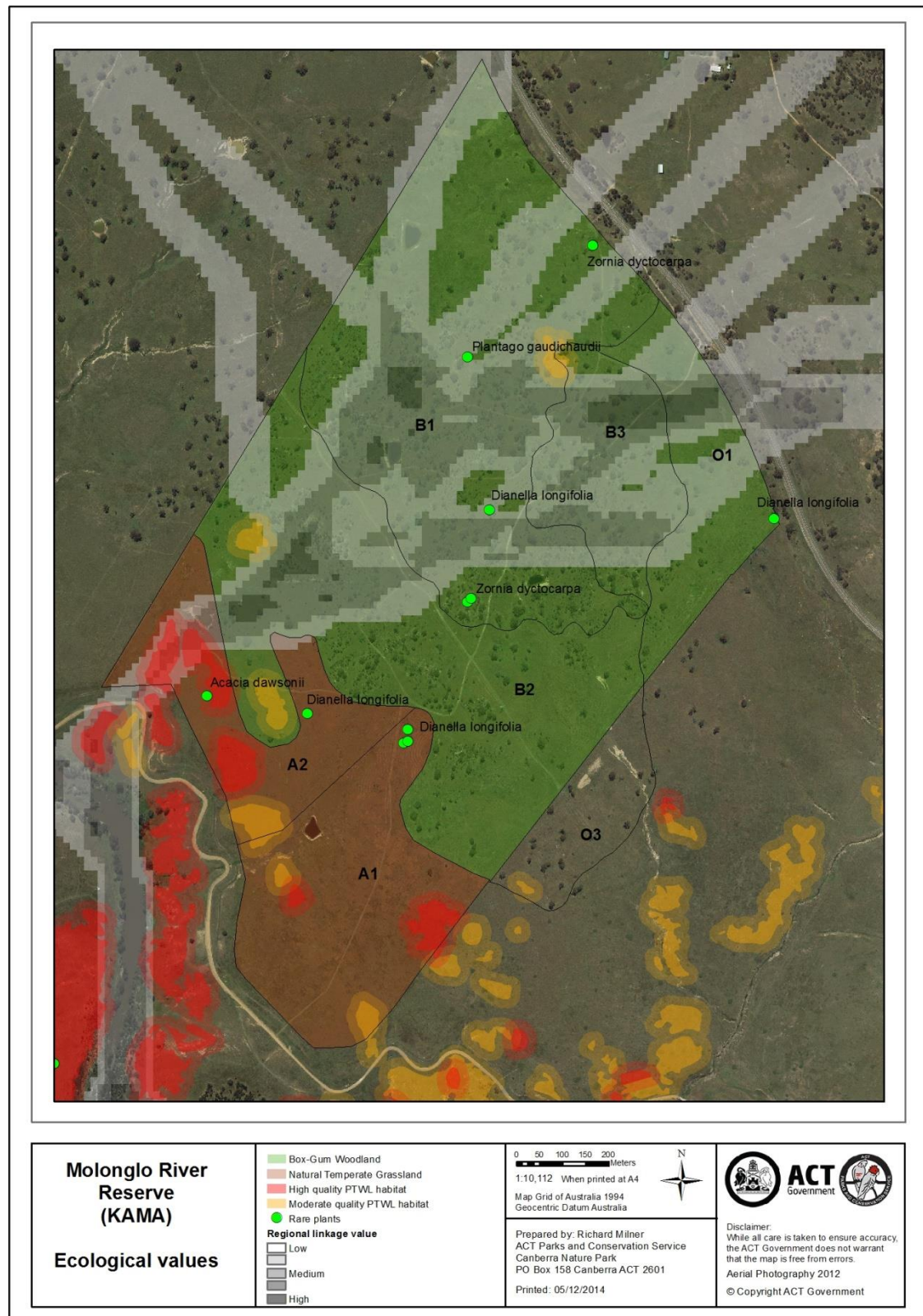


Figure 2. Kama ecological values and NES Patches

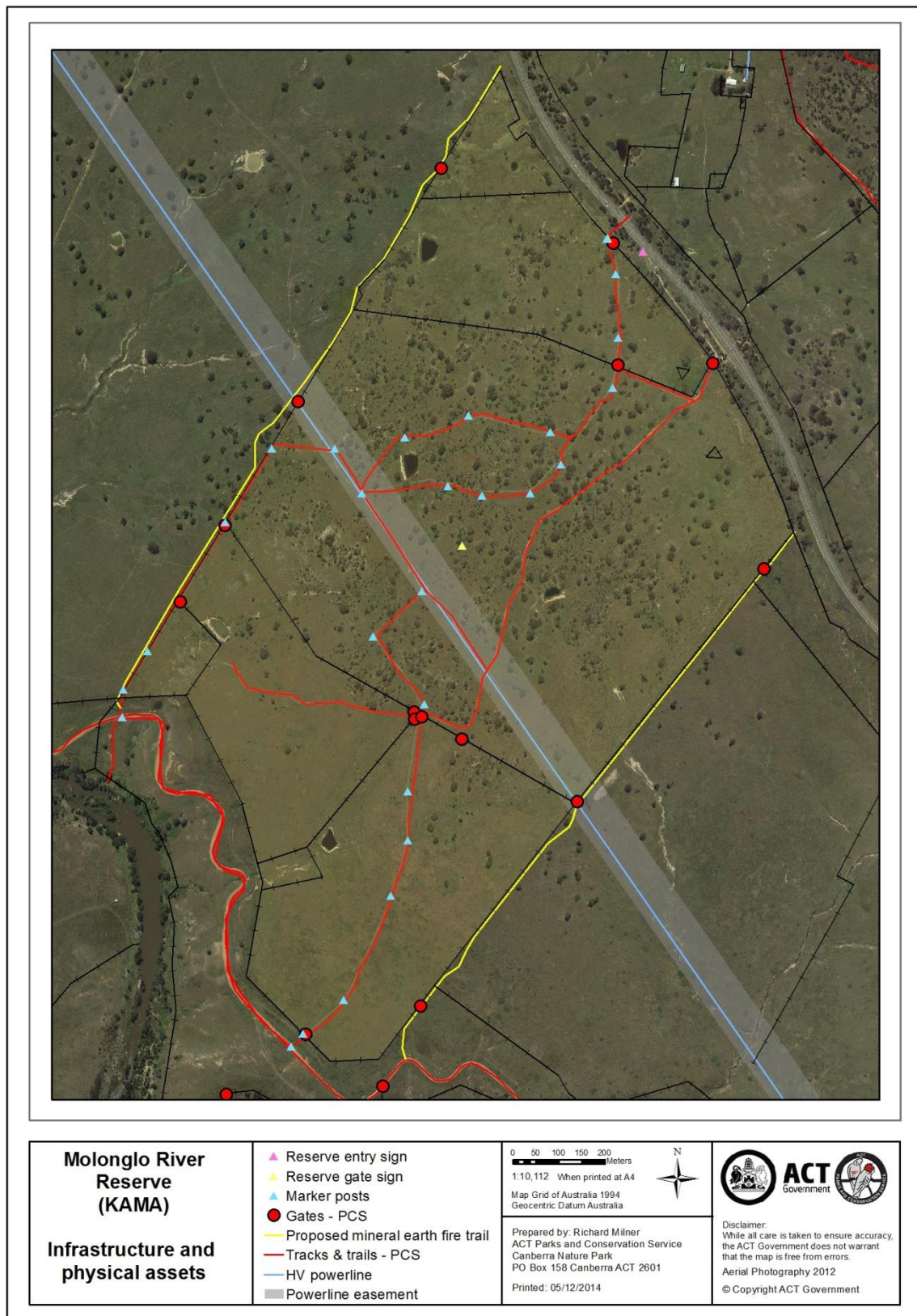


Figure 3. Kama physical assets and infrastructure.



Figure 4. Kama fire history.

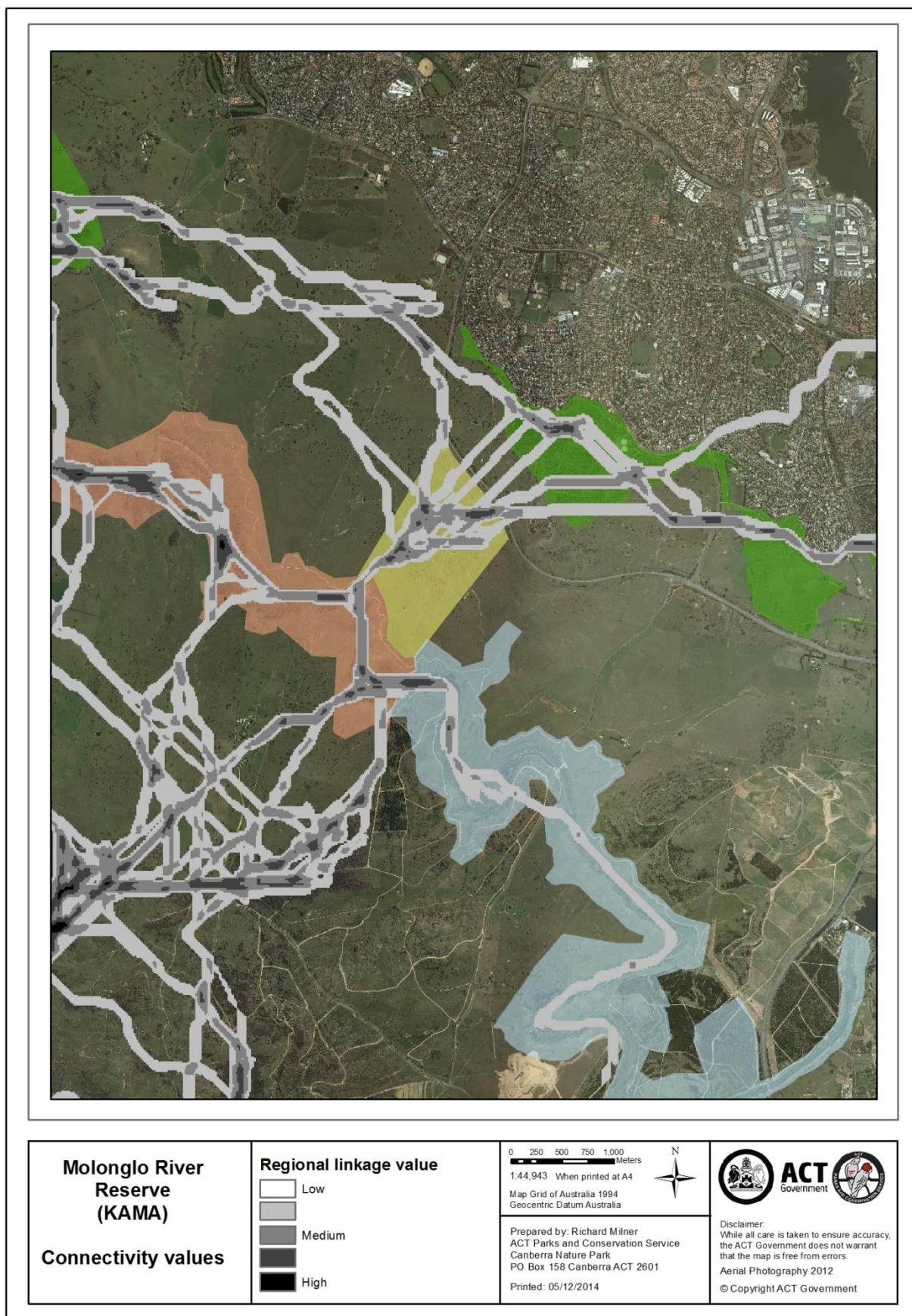


Figure 5. Kama connectivity value.



Figure 6. Kama heritage sites.

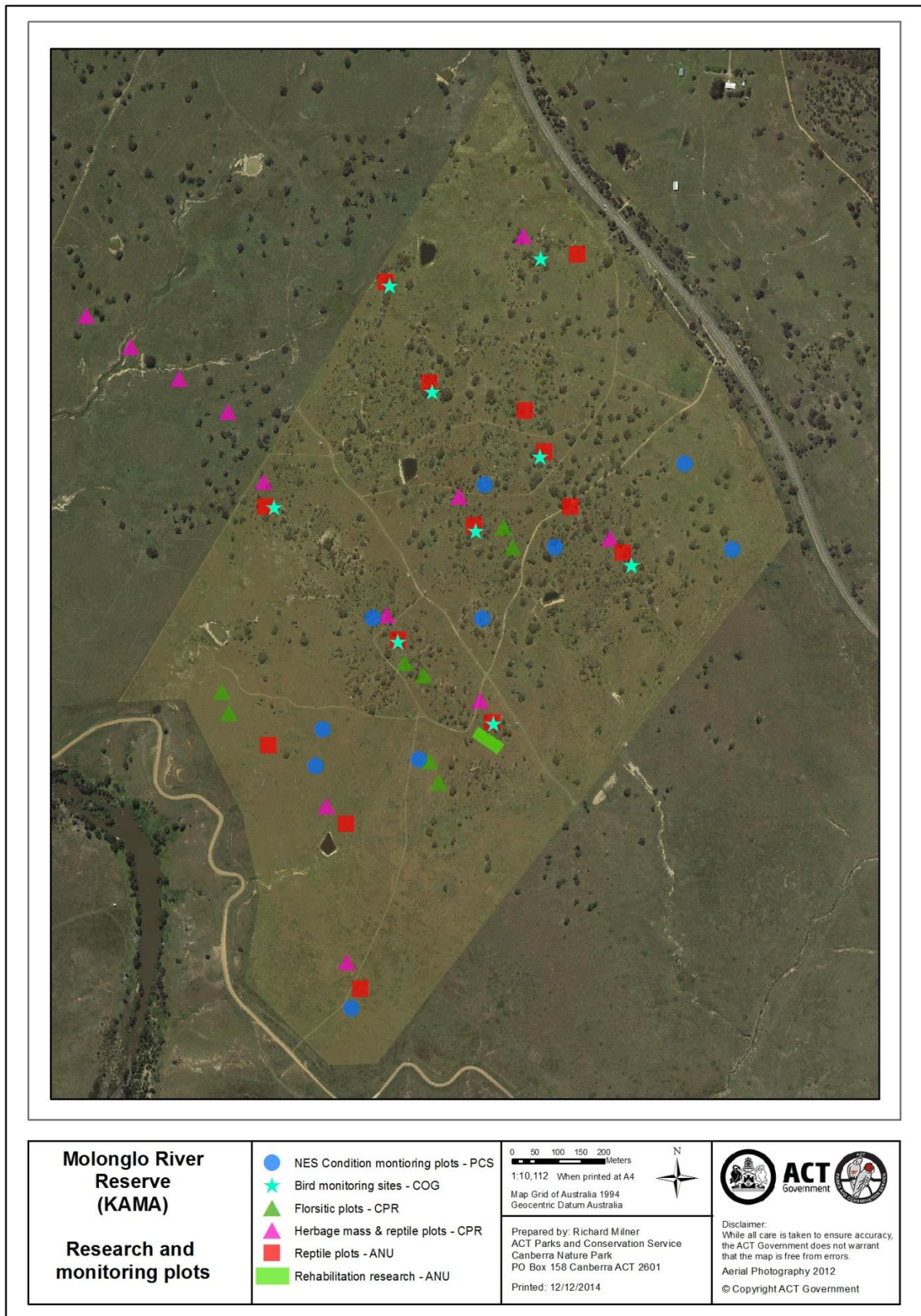


Figure 7. Kama research and monitoring sites.

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Appendix A: Flora Species List

Species present in the patches (Eco Logical Australia 2013; NES monitoring 2013). Figure 2 shows location of rare flora species and Figure 7 shows NES condition monitoring plot locations.

Native species

Vegetation Patch	A	B	O1
<i>Acaena novae-zelandiae</i>	1		
<i>Acaena ovina</i>	1	1	1
<i>Alternanthera nana</i>	1		
<i>Amyema</i> sp.		1	
<i>Aristida ramosa</i>		1	
<i>Arthropodium fimbriatum</i>		1	
<i>Arthropodium milleflorum</i>		1	
<i>Arthropodium</i> sp.		1	
<i>Asperula conferta</i>	1	1	
<i>Astroloma humifusum</i>	1		
<i>Austrostipa bigeniculata</i>	1	1	1
<i>Austrostipa densiflora</i>		1	
<i>Austrostipa scabra</i>	1	1	1
<i>Bossiaea buxifolia</i>		1	
<i>Bothriochloa macra</i>	1	1	
<i>Brachychiton populneum</i>		1	
<i>Brachyloma daphnoides</i>	1	1	
<i>Bracteantha viscosa</i>		1	
<i>Bulbine bulbosa</i>	1	1	
<i>Bursaria spinosa</i> subsp. <i>lasiophylla</i>	1	1	
<i>Carex appressa</i>	1	1	
<i>Carex breviculmis</i>		1	
<i>Carex inversa</i>	1	1	1
<i>Cheilanthes austrotenuifolia</i>		1	
<i>Cheilanthes sieberi</i>	1	1	1
<i>Chloris truncata</i>	1		
<i>Chrysocephalum apiculatum</i>	1	1	
<i>Convolvulus angustissimus</i>	1	1	1
<i>Cymbonotus lawsonianus</i>	1	1	1
<i>Cynoglossum suaveolens</i>	1		
<i>Daucus glochidiatus</i>		1	
<i>Desmodium varians</i>	1	1	1
<i>Dianella longifolia</i> (Rare)	1	1	
<i>Dianella revoluta</i>	1		
<i>Dichelachne</i> sp. (<i>crinita</i>)	1	1	1
<i>Dichelachne mycanthra</i>		1	
<i>Dichondra repens</i>	1		1
<i>Dillwynia sericea</i>		1	

Vegetation Patch	A	B	O1
<i>Einadia nutans</i>		1	1
<i>Eleocharis acuta</i>	1	1	
<i>Elymus scaber</i>	1	1	1
<i>Enneapogon nigricans</i>	1	1	
<i>Epilobium billardiereum</i>	1	1	
<i>Eragrostis brownii</i>		1	
<i>Eryngium ovinum</i>	1	1	
<i>Eucalyptus blakelyi</i>	1	1	1
<i>Eucalyptus dives</i>		1	1
<i>Eucalyptus mannifera</i>		1	1
<i>Eucalyptus melliodora</i>		1	1
<i>Euchiton</i> sp. (native)	1	1	1
<i>Euchiton sphaericus</i>		1	
<i>Galium gaudichaudii</i>	1	1	
<i>Geranium solanderi</i>	1	1	1
<i>Glycine clandestina</i>		1	
<i>Glycine tabacina</i>	1	1	
<i>Gonocarpus tetragynus</i>	1	1	1
<i>Goodenia hederacea</i>	1	1	1
<i>Goodenia pinnatifida</i>		1	
<i>Haloragis heterophylla</i>	1	1	
<i>Hibbertia obtusifolia</i>	1	1	
<i>Hibbertia riparia</i>		1	
<i>Hydrocotyle laxiflora</i>	1	1	1
<i>Hypericum gramineum</i>		1	
<i>Indigofera adesmiifolia</i> (Rare)	1		
<i>Isolepis gaudichaudiana</i>		1	
<i>Isotoma fluviatilis</i>		1	
<i>Juncus australis</i>		1	
<i>Juncus fockei</i>		1	
<i>Juncus</i> sp. (native)	1	1	1
<i>Kunzea ericoides</i>	1		
<i>Lachnagrostis filiformis</i>		1	
<i>Leptorhynchus squamatus</i>	1	1	
<i>Lomandra filiformis</i>	1	1	1
<i>Lomandra filiformis coriacea</i>	1	1	1
<i>Lomandra multiflora</i>	1	1	1
<i>Lomandra</i> sp.		1	
<i>Luzula densiflora</i>	1	1	
<i>Lythrum hyssopifolia</i>	1	1	

Vegetation Patch	A	B	O1
<i>Melichrus urceolatus</i>	1	1	
<i>Microlaena stipoides</i>		1	1
<i>Oxalis perennans</i>	1	1	1
<i>Panicum effusum</i>	1	1	
<i>Pimelia curviflora</i>	1	1	
<i>Plantago varia</i>	1	1	
<i>Poa labillardierei</i>	1		
<i>Poa sieberiana</i>	1	1	1
<i>Rubus parvifolius</i>		1	
<i>Rumex brownii</i>	1	1	1
<i>Rytidosperma caespitosum</i>	1	1	1
<i>Rytidosperma carphoides</i>	1	1	1
<i>Rytidosperma racemosum</i>	1	1	1
<i>Rytidosperma</i> spp (<i>Austrodanthonia</i>)	1	1	1
<i>Schoenus apogon</i>	1	1	1
<i>Senecio</i> sp. (quad)	1	1	1
<i>Stylidium graminifolium</i>	1		
<i>Themeda triandra</i>	1	1	1
<i>Tricoryne elatior</i>	1	1	
<i>Triptilodiscus pygmaeus</i>	1	1	
<i>Typha</i> sp.	1		
<i>Vittadinia cuneata</i>	1	1	1
<i>Vittadinia gracilis</i>		1	
<i>Vittadinia muelleri</i>	1	1	1
<i>Vittadinia</i> sp.		1	
<i>Vulpia muralis</i>		1	
<i>Wahlenbergia communis</i>		1	
<i>Wahlenbergia gracilis</i>		1	
<i>Wahlenbergia luteola</i>	1	1	1
<i>Wahlenbergia</i> sp.	1		1
<i>Wahlenbergia stricta</i>		1	
<i>Wurmbea dioica</i>	1	1	
<i>Xerochrysum viscosum</i>		1	
<i>Zornia dyctiocarpa</i> (Rare)		1	

Exotic Species

Vegetation Patch	A	B	O1
* <i>Acetosella vulgaris</i>	1	1	1
* <i>Aira</i> sp.	1	1	1
* <i>Anagallis arvensis</i>		1	
* <i>Avena</i> sp.	1	1	1
* <i>Briza minor</i>		1	

* <i>Bromus diandrus</i>		1	1
* <i>Bromus hordeaceus</i>	1	1	1
* <i>Bromus rubens</i>	1	1	1
* <i>Bromus</i> sp.	1	1	1
* <i>Carthamus lanatus</i> (Saffron Thistle)	1	1	1
* <i>Centaurium erythraea</i>	1	1	
* <i>Centaurium</i> sp.	1	1	1
* <i>Cerastium</i> sp.		1	
* <i>Chondrilla juncea</i>	1	1	1
* <i>Cirsium vulgare</i> (Spear Thistle)		1	1
* <i>Conyza</i> sp.	1	1	1
* <i>Cynodon dactylon</i>	1		
* <i>Cynosurus echinatus</i>	1	1	
* <i>Cyperus eragrostis</i>	1	1	
* <i>Echium plantagineum</i>	1	1	1
* <i>Eragrostis curvula</i>		1	
* <i>Gamochaeta americana</i>		1	
* <i>Hirschfeldia incana</i>		1	1
* <i>Holcus lanatus</i>	1	1	1
* <i>Hordeum</i> (Critesion) sp.	1	1	
* <i>Hypericum perforatum</i>	1	1	1
* <i>Hypochaeris glabra</i>	1	1	1
* <i>Hypochaeris radicata</i>	1	1	1
* <i>Lactuca saligna</i>	1		
* <i>Lactuca serriola</i>	1	1	1
* <i>Lepidium africanum</i>	1	1	
* <i>Linaria pelisseriana</i>		1	
* <i>Lolium perenne</i>		1	
* <i>Lolium rigidum</i>		1	
* <i>Lycium ferocissimum</i>		1	1
* <i>Malva</i> sp.		1	
* <i>Marrubium vulgare</i>		1	
* <i>Medicago</i> sp.		1	
* <i>Modiola caroliniana</i>	1	1	
* <i>Myosotis discolor</i>	1	1	
* <i>Nassella trichotoma</i>	1		
* <i>Onopordum acanthium</i> (Scotch)		1	
* <i>Orobanche minor</i>	1	1	
* <i>Paronychia brasiliensis</i>		1	1
* <i>Paspalum dilatatum</i>	1	1	
* <i>Petrorhagia nanteuilii</i>	1	1	1
* <i>Phalaris aquatica</i>	1	1	1
* <i>Plantago lanceolata</i>	1	1	1
* <i>Rosa rubiginosa</i>	1	1	1

* <i>Rubus fruticosus</i>	1	1	1
* <i>Salvia verbenaca</i>		1	1
* <i>Solanum nigrum</i>	1	1	
* <i>Sanguisorba minor</i>	1		
* <i>Sherardia arvensis</i>		1	
* <i>Silene gallica</i>		1	
* <i>Sonchus asper</i>	1	1	
* <i>Sonchus sp. (Sow thistle)</i>	1	1	
* <i>Spergularia rubra</i>		1	
* <i>Taraxacum sect. ruderalia</i>		1	
* <i>Taraxacum sp.</i>	1		
* <i>Tolpis barbata</i>	1	1	
* <i>Tradescantia spathacea</i>		1	
* <i>Tragopogon sp.</i>	1	1	1
* <i>Trifolium angustifolium</i>		1	1
* <i>Trifolium arvense</i>	1	1	
* <i>Trifolium campestre</i>	1		
* <i>Trifolium glomeratum</i>		1	
* <i>Trifolium sp.</i>	1	1	1
* <i>Verbascum thapsus</i>	1	1	1
* <i>Verbascum virgatum</i>	1	1	
* <i>Vulpia sp.</i>	1	1	1

Vegetation Patch	A	B	O1
Total native species	72	99	40
Total introduced species	46	65	32
Total unknown species	1	1	
Percentage native species	61	60	56

Appendix B: Fauna Species List

Species	Common Name	Birds Australia	Breeding
<i>Tachybaptus novaehollandiae</i>	Australian Grebe	61	
<i>Falco longipennis</i>	Australian Hobby	235	
<i>Alisterus scapularis</i>	Australian King-parrot	281	
<i>Gymnorhina tibicen</i>	Australian Magpie	705	y
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	317	
<i>Rostratula benghalensis</i>	Australian Painted Snipe		
<i>Corvus coronoides</i>	Australian Raven	930	y
<i>Chenonetta jubata</i>	Australian Wood Duck	202	y
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	424	y
<i>Elseya melanops</i>	Black-fronted Dotterel	144	
<i>Elanus axillaris</i>	Black-Shouldered Kite	232	y
<i>Falco berigora</i>	Brown Falcon	239	y
<i>Accipiter fasciatus</i>	Brown Goshawk	221	
<i>Acanthiza pusilla</i>	Brown Thornbill	475	
<i>Climacteris picumnus</i>	Brown Treecreeper	555	y
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	583	
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	484	y
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	222	
<i>Turdus merula*</i>	Common Blackbird	991	
<i>Acridotheres tristis *</i>	Common Myna	998	y
<i>Ocyphaps lophotes</i>	Crested Pigeon	43	
<i>Falcunculus frontatus</i>	Crested Shrike-tit	416	
<i>Platycercus elegans</i>	Crimson Rosella	282	y
<i>Stagonopleura guttata</i>	Diamond Firetail	652	y
<i>Eurystomus orientalis</i>	Dollarbird	318	y
<i>Artamus cyanopterus</i>	Dusky Woodswallow	547	y
<i>Platycercus eximius</i>	Eastern Rosella	288	y
<i>Carduelis carduelis*</i>	European Goldfinch	997	
<i>Sturnus vulgaris*</i>	European Starling	999	y
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater	613	
<i>Eolophus roseicapilla</i>	Galah	273	y
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	268	
<i>Pachycephala pectoralis</i>	Golden Whistler	398	
<i>Cracticus torquatus</i>	Grey Butcherbird	702	
<i>Stepera versicolor</i>	Grey Currawong	697	y

<i>Rhipidura albiscapa</i>	Grey Fantail	361	y
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	408	
<i>Anas gracilis</i>	Grey Teal	211	y
<i>Chrysococcyx basalis</i>	Horsfield's Bronze-cuckoo	342	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	322	
<i>Corvus mellori</i>	Little Raven	954	
<i>Acanthiza nana</i>	Little Thornbill	471	
<i>Grallina cyanoleuca</i>	Magpie-Lark	415	y
<i>Vanellus miles</i>	Masked Lapwing	133	
<i>Dicaeum hirundinaceum</i>	Mistletoebird	564	
<i>Falco cenchroides</i>	Nankeen Kestrel	240	y
<i>Philemon corniculatus</i>	Noisy Friarbird	645	
<i>Manorina melanocephala</i>	Noisy Miner	634	y
<i>Oriolus sagittatus</i>	Olive-backed Oriole	671	
<i>Anas superciliosa</i>	Pacific Black Duck	208	
<i>Cacomantis pallidus</i>	Pallid Cuckoo	337	
<i>Strepera graculina</i>	Pied Currawong	694	
<i>Merops ornatus</i>	Rainbow Bee-eater	329	
<i>Anthochaera carunculata</i>	Red Wattlebird	638	
<i>Neochmia temporalis</i>	Red-browed Finch	662	
<i>Psephotus haematonotus</i>	Red-rumped Parrot	295	y
<i>Myiagra inquieta</i>	Restless Flycatcher	369	
<i>Anthus novaeseelandiae</i>	Richard's Pipit	647	
<i>Cincloramphus mathewsi</i>	Rufous Songlark	509	y
<i>Pachycephala rufiventris</i>	Rufous Whistler	401	
<i>Todiramphus sanctus</i>	Sacred Kingfisher	326	
<i>Petroica boodang</i>	Scarlet Robin	380	
<i>Zosterops lateralis</i>	Silvereye	574	
<i>Alauda arvensis*</i>	Skylark	993	
<i>Aphelocephala leucopsis</i>	Southern Whiteface	466	y
<i>Chthonicola sagittata</i>	Speckled Warbler	504	
<i>Pardalotus punctatus</i>	Spotted Pardalote	565	
<i>Pardalotus striatus</i>	Striated Pardalote	976	y
<i>Coturnix pectoralis</i>	Stubble Quail	9	
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	269	y
<i>Malurus cyaneus</i>	Superb Fairy-wren	529	y
<i>Polytelis swainsonii</i>	Superb Parrot	277	

<i>Lathamus discolor</i>	Swift Parrot	309	
<i>Petrochelidon nigricans</i>	Tree Martin	359	y
<i>Neophema pulchella</i>	Turquoise Parrot	302	
<i>Daphoenositta chrysoptera</i>	Varied Sittella	549	y
<i>Aquila audax</i>	Wedge-tailed Eagle	224	
<i>Smicronis brevirostris</i>	Weebill	465	y
<i>Hirundo neoxena</i>	Welcome Swallow	357	y
<i>Gerygone fusca</i>	Western Gerygone	463	
<i>Artamus superciliosus</i>	White-browed Woodswallow	545	
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	617	
<i>Egretta novaehollandiae</i>	White-faced Heron	188	
<i>Melithreptus lunatus</i>	White-naped Honeyeater	578	
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	625	y
<i>Gerygone olivacea</i>	White-throated Gerygone	453	
<i>Cormobates leucophaeus</i>	White-throated Treecreeper	558	
<i>Corocorax melanorhamphos</i>	White-winged Chough	693	
<i>Lalage sueurii</i>	White-winged Triller	430	y
<i>Rhipidura leucophrys</i>	Willie Wagtail	364	y
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	614	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	486	y
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo	267	

Appendix C: Past and current survey, monitoring restoration and research programs

Figure 7 shows the locations of these studies.

Survey:

- Woodland and grassland mapping and vegetation survey – CPR: 2002-03 (not published); Eco Logical Australia (2009)
- Threatened species surveys – CPR unpublished; Eco Logical Australia 2009
- Baseline Condition Assessment – Eco Logical Australia 2013
- Landscape Functional Analysis – Sarah Sharp (2011)
- Pink-tailed Worm-lizard survey – Osborne and Wong 2013

Monitoring

- Biomass and floristic diversity monitoring – CPR (ongoing)
- Kangaroo population dynamics – CPR (ongoing)
- Grassland vegetation diversity monitoring program – CPR (ongoing)
- Woodland Bird monitoring study – Canberra Ornithologists Group (ongoing)
- NES vegetation and habitat condition monitoring – TAMS (ongoing)
- Lizard monitoring under tiles – CPR (ongoing)

Research

- Revegetation techniques - Fenner School, ANU (current)

Restoration

- Woodland Restoration Program – TAMS (current)

Appendix D: Funding source, schedule and estimates

Funding Source	Code	2014-15	2015-16	2016-17	2017-18
Molonglo Capital Works	Mcw	\$2602K			
Molonglo Recurrent	Mrec	\$452K	\$510K		
NES Capital Works	NEScw	\$1025K	\$850K	\$812K	\$792K
NES Recurrent	NESrec		\$236K	\$238K	\$265K
Canberra Nature Park Recurrent*	CNPrec				

*Funding contribution from CNP north district = staff time