



Department of  
Primary Industries and  
Regional Development

# Western Australian Large Feral Herbivore Strategy 2020–2025



### **Important disclaimer**

The Chief Executive Officer of the Department of Primary Industries and Regional Development and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.

**Copyright © Department of Primary Industries and Regional Development, 2020**

Copies of this document may be available in alternative formats upon request.

3 Baron-Hay Court, South Perth WA 6151

Tel: +61 (0)8 9368 3333

Email: [enquiries@dpird.wa.gov.au](mailto:enquiries@dpird.wa.gov.au)

Website: [dpird.wa.gov.au](http://dpird.wa.gov.au)

## Contents

<b>Acknowledgements</b> .....	<b>ii</b>
<b>Glossary</b> .....	<b>iii</b>
<b>List of Acronyms</b> .....	<b>vi</b>
<b>Executive summary</b> .....	<b>1</b>
<b>Purpose of the strategy</b> .....	<b>1</b>
<b>Vision</b> .....	<b>2</b>
<b>Guiding principles for this Strategy</b> .....	<b>2</b>
<b>The role of the Strategy within the National and State policy framework</b> .....	<b>4</b>
<b>Background and context</b> .....	<b>6</b>
Large feral herbivores .....	6
Responsibility for LFH management.....	6
LFH distribution and abundance.....	8
Feral donkeys.....	8
Feral horses .....	8
Feral camels.....	9
LFH impacts .....	13
LFH management techniques in WA .....	14
Key success factors for effective LFH management .....	16
<b>Goals and strategies</b> .....	<b>17</b>
<b>Goal 1: LFH management is collaborative, coordinated and integrated</b> .....	<b>18</b>
<b>Goal 2: LFH management is innovative, effective and cost-efficient</b> .....	<b>21</b>
<b>Goal 3: LFH management is adequately resourced and ongoing</b> .....	<b>24</b>
<b>Goal 4: Reporting mechanisms support effective LFH management and facilitate stakeholder engagement</b> .....	<b>25</b>
<b>Goal 5: LFH management is undertaken to the highest animal welfare standards and complies with all relevant legislation</b> .....	<b>26</b>
<b>Goal 6: The Western Australian public is supportive of LFH management</b> .....	<b>27</b>
<b>Implementation</b> .....	<b>28</b>
<b>Appendix 1: Control techniques and considerations of LFH</b> .....	<b>29</b>
<b>Appendix 2: Stakeholder roles and responsibilities</b> .....	<b>31</b>
<b>References</b> .....	<b>35</b>

## Acknowledgements

The Department of Primary Industries and Regional Development (DPIRD) would like to thank Growing Australia, who led the consultation process, and the Large Feral Herbivore steering committee and WA stakeholders for their expertise and input into developing the Strategy. This included representatives of the following:

- Department of Biodiversity, Conservation and Attractions
- Department of Planning, Lands and Heritage
- Department of Water and Environment Regulation
- Industry
- Landholders
- Licensed Pest Management Technicians
- Local Government Authorities
- Non-for-profit conservation and animal welfare organisations
- Recognised Biosecurity Groups in the Rangelands: Kimberley Rangelands Biosecurity Association, Pilbara Regional Biosecurity Group, Goldfields-Nullarbor Rangelands Biosecurity Association, Meekatharra Rangelands Biosecurity Association, and Carnarvon Rangelands Biosecurity Association
- Regional Natural Resource Management organisations, Land Conservation District Committees, and catchment groups
- Traditional Owners
- Vertebrate pest management groups
- Water Corporation

Numerous other groups and individuals also lent their expertise. The contribution of all who attended workshops, phone interviews and otherwise provided input is greatly appreciated.

The Department notes that the Strategy document does not necessarily reflect the views or policies of the organisations or individuals who participated in the consultation process.

## Glossary

Animal Welfare Act	<b><i>Animal Welfare Act 2002</i></b>
Australian Government	In the context of the strategy, refers only to those National or central government departments responsible for invasive species and biosecurity.
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
Biosecurity	Has the meaning assigned under the <i>Biosecurity and Agriculture Management Act 2007</i> , namely ‘ <i>protection from the adverse effect an organism has or may have on:</i> <ul style="list-style-type: none"> <li>• <i>another organism</i></li> <li>• <i>a human being</i></li> <li>• <i>the environment, or part of the environment</i></li> <li>• <i>agricultural activities, fishing or pearling activities, or related commercial activities carried on, or intended to be carried on, in the State or part of the State</i>’.</li> </ul>
Category D firearm	Self-loading firearm with a magazine capacity of more than five rounds used to meet best practice animal welfare standards for rapid and humane control of LFH.
C3 Management	A control category that declared pests may be assigned under regulation 8 of the Biosecurity and Agriculture Management Regulations 2013. Landholders have the obligation to manage C3 organisms in order to alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism, or prevent or contain the spread of the organism.
Containment	The application of measures in and around an infested area to stop or prevent the spread of invasive species, which may include reduction of the density in the area of infestation, or eradication of satellite infestations.
Control	In relation to a declared pest or other organism, includes eradicate, destroy, prevent the presence or spread of, manage, examine or test for, survey for or monitor the presence or spread of, treat and mitigate impact.
Declared pest	A species declared by the relevant Minister to be prohibited under section 12 of the <i>Biosecurity and Agriculture Management Act 2007</i> , or a pest under section 22(2) of the <i>Biosecurity and Agriculture Management Act 2007</i> .
Eradication	Removal of an entire population of an invasive species from an area.
Established pest animal	A pest animal that is perpetuated, for the foreseeable future, within any area and where it is not feasible (whether in terms of technical feasibility or a cost-benefit analysis) to eradicate.

Impact	The (usually) negative economic, environmental and/or social effects of invasive species.
Incursion	A newly established population of a non-native organism detected in an area (e.g. country, jurisdiction, region or site). Re-invasion of a previously eradicated species is considered a new incursion.
Industry	Agriculture, forestry, fisheries and mining sectors involved in the commercial use of natural resources, to grow, harvest, extract and process the products used in everyday lives.
Invasive species	Terrestrial and aquatic plants, vertebrates and invertebrates that have actual or potential undesirable impacts on economic, environmental or social values in a new environment where they are not native.
Jurisdictions	Refers collectively to Australian, State, Territory, and local governments.
Landholder	Individuals, companies, organisations and governments that own, lease or manage private, commercial or government land.
Large feral herbivores	In the context of this strategy, un-owned donkeys ( <i>Equus asinus</i> ), horses ( <i>Equus caballus</i> ), their hybrids, and Arabian (dromedary) camels ( <i>Camelus dromedarius</i> ) that live in the wild but are descended from domesticated animals.
Large feral herbivore management	As used in this Strategy, large feral herbivore management encompasses prevention, eradication, containment and control of large feral herbivores and asset-based protection.
Management	For pests declared under the <i>Biosecurity and Agriculture Management Act 2007</i> , control category 3 (C3). Management aims to reduce the distribution or prevent or contain spread of the declared pest in an area to alleviate harmful impacts of the pest.
Pest animal	A species that has the potential to cause either direct or indirect, harm to human, animal or plant health; or the environment (amended from the <i>Biosecurity Act 2015</i> ).
Pastoral zone	Area of land, other than land in the ‘agricultural zone’, which is used principally for pastoral purposes (the grazing of livestock on native vegetation) within the rangelands of the State.
Prevention	Management strategies including regulatory and physical measures to ensure that incursions of invasive species are prevented or their impacts mitigated.
Rangelands	Land where livestock graze extensively on native vegetation and where rainfall is considered to be too low or too erratic for agricultural cropping or for improved pastures. Rangelands cover about 2.2M km <sup>2</sup> (87% of WA), and consist of pastoral stations (~860,000 km <sup>2</sup> ) <sup>1</sup> , land vested for conservation, Indigenous and unallocated Crown land.

---

<sup>1</sup> Based on active pastoral leases as at June 2016

Removal	Activity that causes the removal of the feral animal through humane means.
Recognised Biosecurity Group	Formally recognised groups by the Minister of Agriculture and Food for the purpose of declared pest control in their area of operation.
Reporting mechanism	Any tool, application or communication channel through which invasive species reports can be made (for example, functions and resources for mapping species distribution).

---

## List of Acronyms

<b>APAS</b>	Australian Pest Animal Strategy
<b>AW Act</b>	<i>Animal Welfare Act 2002</i>
<b>BAM Act</b>	<i>Biosecurity and Agriculture Management Act 2007</i>
<b>BC Act</b>	<i>Biodiversity Conservation Act 2016</i>
<b>CALM Act</b>	<i>Conservation and Land Management Act 1984</i>
<b>COP</b>	Code of Practice
<b>DBCA</b>	Department of Biodiversity, Conservation and Attractions
<b>DPIRD</b>	Department of Primary Industries and Regional Development
<b>DPLH</b>	Department of Planning, Lands and Heritage
<b>DPR</b>	Declared Pest Rate
<b>DWER</b>	Department of Water and Environment Regulation
<b>IGAB</b>	Intergovernmental Agreement on Biosecurity
<b>LFH</b>	Large feral herbivores
<b>NRM</b>	Natural Resource Management
<b>RBG</b>	Recognised Biosecurity Group
<b>SOP</b>	Standard Operating Procedure
<b>WA</b>	Western Australia



## Executive summary

Management of invasive species is an important component of biosecurity, sustainable land management and conservation of natural values. Managing effectively the populations of those species already established in Western Australia (WA), including large feral herbivores (LFH), implies reducing their impacts and detecting the occurrence of new populations to prevent further harm to the State's agriculture and biodiversity. Effective management includes monitoring the density and distribution of established populations to determine their boundaries and monitor the effectiveness of control programs.

The foundations for a national biosecurity framework for vertebrate pests are based on the Australian Pest Animal Strategy (APAS) developed by the Invasive Plants and Animals Committee in 2016. The LFH Strategy (this Strategy) outlines the principles of the APAS and underpins a high-level approach to the management of LFH across five regions; Kimberley, Pilbara, Carnarvon, Meekatharra, and Goldfields-Nullarbor of Western Australia from 2020–2025.

## Purpose of the strategy

The Strategy has been developed by the Department of Primary Industries and Regional Development (DPIRD) to provide guidance to stakeholders on a strategic approach to the management of LFH in the rangelands of WA. This is the first Strategy developed for LFH in WA.

It describes the principles of effective LFH management, setting the goals and priorities that will help improve WA's ability to deliver economic, environmental and social benefits through improved LFH management. The Strategy guides and informs stakeholders responsible for the on-ground management of LFH, rather than prescribing detailed on-ground actions and activities.

The effective LFH management requires a long-term, well-resourced, tenure-blind, coordinated approach and the active involvement of all key stakeholders. This includes the participation of State government agencies, local governments, Recognised Biosecurity Groups (RBGs), regional Natural Resource Management (NRM) bodies, pastoralists, Traditional Owners, non-government organisations, mining companies and research institutions. The ongoing support of the general public will ensure that public funding continues to be applied to LFH management.

The Strategy recognises that in some instances LFH may have cultural significance or commercial value, particularly for Traditional Owners, however these appreciations must be balanced with the obligation to manage these declared species.

Expert recommendations and an extensive stakeholder consultation process have been considered in the elaboration of this document. Their input has helped identify where LFH management is working effectively and where, with increased collaboration, cooperation and resourcing, improvements in LFH management may be gained.

Finally, the Strategy identifies a range of key management opportunities and challenges. Some of the identified opportunities can be achieved through increased cooperation and collaboration and can be readily implemented at little or no cost. Others will require significant additional research, planning, time or funding to implement.

## Vision

The Vision for the Strategy is:

Large Feral Herbivore management is an integral part of the sustainable management of natural resources of the rangelands for the benefit of the economy, environment, human health and social and cultural wellbeing of the community.

## Guiding principles for this Strategy

The following principles of LFH management underpin this Strategy

### **Large feral herbivores are managed to ensure sustainability of natural resources**

LFH management is an integral part of the sustainable management of natural resources for the benefit of the pastoral industry, the environment, human health and amenity. Primary production and ecosystems need to be protected from negative impacts of LFH. Such impacts include competition for resources, habitat degradation, spread of weeds, damage to human-made infrastructure and potential disease transmission. These threats have the ability to interact with other threats, to further degrade natural values.

### **Management is more effective with the participation of all stakeholders**

LFH management benefits from a coordinated approach among all levels of government, industry, natural resource managers, community groups and individuals. All stakeholders should be involved in decision-making regardless of land tenure. Combating declared pest problems requires all parties to have a clear understanding and acceptance of their roles and responsibilities.

### **Decision-making and prioritisation need to be risk-based and informed by evidence**

The development, monitoring and review of integrated LFH management should be based on robust evidence, intelligence and analysis. Monitoring of LFH management enables evaluation of changing dynamics (population density and distribution) to inform management activities. Decisions on how to allocate resources for the LFH management should be evidence-based and informed by a risk management approach. The benefits of management should exceed the costs of implementing control and the losses to natural and cultural assets.

### **Large feral herbivore management is strategic**

Management of LFH should be strategic in order to maximise both effectiveness and return on investment. Management should be proactive and well planned to ensure that management actions are undertaken in appropriate locations, at the optimum time using the most appropriate techniques. Prevention and early intervention are the most cost-effective techniques.

Management should address actual rather than perceived problems, and to reduce impacts rather than animal numbers. Management must be continued in perpetuity, even when LFH densities are low, in order to prevent populations re-establishing. As part of an integrated LFH management program, commercial harvesting may offset management costs in some circumstances.

### **Large feral herbivore management embraces new technologies and innovation**

Research and development can identify and evaluate new technologies to be used in LFH management. This can introduce new, efficient ways or improve existing methods of applying limited resources to LFH management.

### **Capacity building is essential to ensure effective LFH management**

Effective LFH management requires capacity of government, landholders and the community to be adequate for the task. Management activities should be sufficiently resourced, and capacity building should be prioritised. Stakeholders require specific skills, tools and resources to undertake effective LFH management. Cooperation and collaboration at the landscape-scale should be promoted, while effective leadership adequate with the local, regional or state-wide scale of the management activity or role should be identified, fostered and resourced to maximise collective impact.

## The role of the Strategy within the National and State policy framework

This Strategy meets the State’s responsibilities under the Australian Pest Animal Strategy, and supports the Western Australian Biosecurity Strategy 2016–2025 and the Invasive Species Plan for Western Australia 2015–2019 (Figure 1).

### National and State policy framework

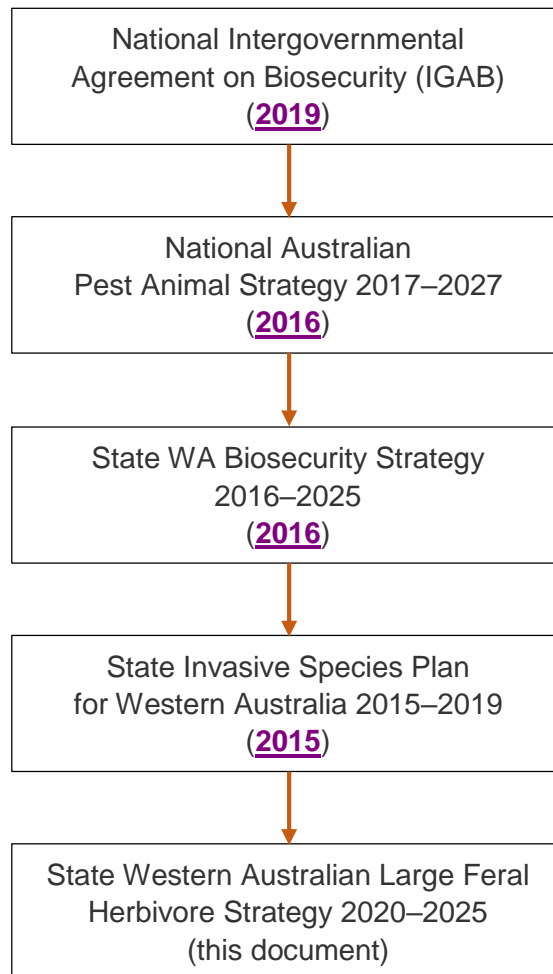


Figure 1. Policy framework for management of large feral herbivores in Western Australia

## **Intergovernmental Agreement on Biosecurity (IGAB)**

The IGAB was established to enhance Australia’s biosecurity system and strengthen the collaborative approach between the Federal government and State and Territory governments to address Australia’s broad range of biosecurity issues. The IGAB is primarily for animal and plant pests and diseases in aquatic and terrestrial environments. The agreement recognises that biosecurity is a shared responsibility and sets out the principles that underpin the national biosecurity system.

## **Australian Pest Animal Strategy**

The National Australian Pest Animal Strategy 2017–2027 is a vital part of Australia’s integrated approach to national biosecurity under the AusBIOSEC. The strategy sets the direction for national pest animal management and encourages collaboration. It includes priorities to improve early detection, diagnostics and response for priority pest animals.

## **WA Biosecurity Strategy**

The WA Biosecurity Strategy 2016–2025 sets the strategic direction for partnership arrangements to manage biosecurity issues affecting agriculture, fisheries, forestry and biodiversity in terrestrial and aquatic environments. The strategy covers pest animals and plants, and animal and plant diseases. It acknowledges that an effective biosecurity system must manage risks across the entire biosecurity continuum, and emphasises the importance of preventing incursions as well as detecting them early.

## **Invasive Species Plan for Western Australia**

The Invasive Species Plan for Western Australia 2015–2019 identifies actions for a coordinated approach to manage existing and potential invasive species. It defines invasive species as vertebrate animals and plants that can cause undesirable impacts on economic, environmental and social assets and values.

The plan provides for greater involvement in pest surveillance by all stakeholders, and the use of improved ways of identifying and reporting pests. Developing a post-border surveillance strategy relevant to industry, community and government will help achieve this coordinated approach.

## Background and context

### Large feral herbivores

In the context of this Strategy, LFH are defined as unowned donkeys (*Equus asinus*), horses (*Equus caballus*) and their hybrids, and Arabian (dromedary) camels (*Camelus dromedarius*) that live in the wild but are descended from domesticated animals. Each species is well established in the arid and semi-arid rangelands of WA.

These species are declared pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and fall within the C3 control category under the Biosecurity and Agriculture Management Regulations 2013. Under WA legislation, these species are required to be managed to alleviate their harmful impact, reduce their numbers or distribution and contain their spread.

### Responsibility for LFH management

DPIRD is the lead agency for the Western Australian Large Feral Herbivore Strategy 2020–2025. DPIRD is responsible for the administration of the BAM Act, including compliance with the Act, and the declaration of pest species within the Act. DPIRD provides post-border surveillance and coordinates surveillance and reporting from industry and community, including biosecurity groups.

All land owners and landholders including Australian, State and local governments, Traditional Owners, pastoralists, the mining industry, and private landowners are required under the BAM Act to control LFH on land under their jurisdiction (Figure 2). Roles and responsibilities of each group are outlined in Appendix 2.

It is recognised that effective management of these highly mobile species is best conducted at a strategic level with strong partnership arrangements that support individual landholders. The BAM Act enables landholders to work in collaboration with others, including government agencies, using the mechanisms and resources available under the Act. For example, partnerships between private landholders and government can be achieved through Recognised Biosecurity Groups (RBGs). It is also recognised that regional NRM organisations are key collaborators with all landholders, Australian, State and local governments, and RBGs, and can foster and support valuable partnerships that increase the capacity of collective responses to the landscape scale issue of LFH infestation and management.



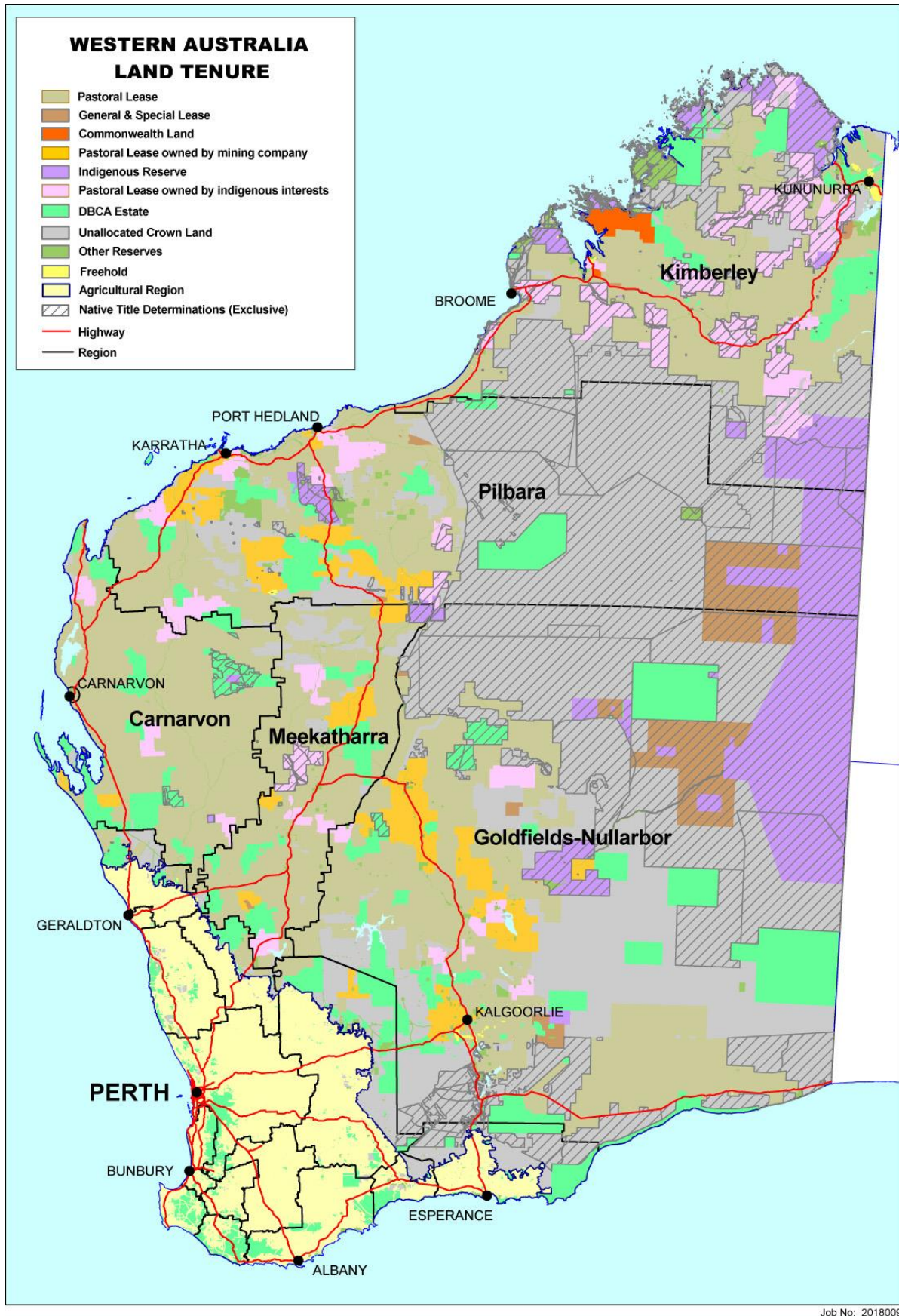


Figure 2. Land tenure including Exclusive Native Title Determinations in WA rangelands. Pastoral leases reflect areas of RBG operations within each region discussed in this document

## Recognised Biosecurity Groups

In the WA rangelands, pastoral leases are administered by the Department of Planning, Lands and Heritage through the Pastoral Lands Board, which is responsible for ensuring that pastoral leases are managed on a sustainable basis. The majority of LFH management programs within the pastoral leases are coordinated by RBGs, which are made up of landholders. RBGs are DPIRD's partnership arrangement under the BAM Act for the control of widespread and established declared pests, including LFH.

RBGs support and complement activities that individual landholders are required to undertake to meet their legal obligations to control declared pests on their land. They also provide a framework to foster efficiency through arrangements that make the best use of skills, funds, capacities, incentives and regulations.

RBG activities are funded through the declared pest rate (DPR) paid annually by pastoral lease landholders, including leases owned by mining and Indigenous interests, which is matched dollar-for-dollar by the State government. Funding is allocated yearly by each RBG to manage high priority animal and plant pests within their area of operation. RBGs may also receive funds from other sources including Australian, State and local government funds, regional NRM grants, and grants from private conservation organisations. The limited funds available to the RBGs sees a focus upon mitigating LFH impacts on the pastoral lease estate. In the pastoral lease/desert interface, there have been some examples of cooperation and collaboration between desert landholders (Traditional Owner ranger groups), the neighbouring pastoralists, and State and local governments as a result of coordinated actions by the RBGs.

## LFH distribution and abundance

Feral donkeys, horses and camels are well established in the arid and semi-arid rangelands of WA. Reliable data on population size and densities of all three species is sparse, because they occupy remote and rugged terrain that is difficult and costly to survey. These species can move considerable distances and their numbers fluctuate with seasons. In that sense, the remote and rugged nature of much of WA poses challenges for managing LFH.

The distribution and density of all three LFH species is strongly dependent upon the availability of feed, water and shelter. In the arid rangelands, availability of feed and water is closely linked to rainfall quantity and distribution, which can vary substantially from year to year. In the pastoral areas, the provision of water for domestic livestock has provided LFH with access to permanent and reliable water supplies.

### Feral donkeys

Feral donkeys are adapted to arid regions and tropical savannas. Widespread populations of feral donkeys occur in the Northern Territory and arid Central Australia. In WA, they commonly occur in the Kimberley and Pilbara, with smaller localised populations in Murchison, Carnarvon and the Goldfields regions (Woolnough *et al.* 2005; Figure 3). While there is no current population estimate for donkeys in WA, over 600 000 donkeys have been removed from the Kimberley and Pilbara regions over the last 40 years through coordinated management programs (Zabek *et al.* 2018).

### Feral horses

The number of feral horses in Australia has been previously estimated to be in excess of 400 000 (Dawson *et al.* 2006), however no coordinated census has been undertaken to estimate the population size in the last 30 years. Feral horses occur in every mainland State



and Territory of Australia, usually in remote areas. In WA, feral horse populations are dispersed widely across the State but are predominantly located in the rangelands. These occur mostly in the Pilbara, Kimberley and the Goldfields (Figure 4); however, their exact number is not known (Woolnough *et al.* 2005).

### **Feral camels**

Feral camels are widely, but not evenly distributed through much of arid Australia. Recent estimates place the feral camel population at around 300 000 across Australia (Lethbridge *et al.* 2016); however, this number may be underestimated because of the lack of aerial surveys in the low-density areas of inland Australia. In WA, feral camels occur in the eastern rangelands, with occurrence increasing towards the desert country. Nearly 48 000 feral camels were removed from WA during the 2009-2013 Australian Feral Camel Management Project, which reduced the population density in surveyed areas in the Pilbara region to less than 0.1 camels/km<sup>2</sup> (Lethbridge *et al.* 2016). Nevertheless, the Great Sandy Desert and Great Victoria Desert remain as two areas with the highest population numbers nationally (Figure 5).

Feral camels are highly mobile and can move over large distances in relatively short time periods (Edwards *et al.* 2008). They respond to declining feed and water availability by moving to areas where these are in greater supply, often travelling long distances. Their mobile nature is particularly troublesome in times of drought when feral camels move from the western desert areas of WA onto pastoral leases and national parks, damaging fences and water supplies and competing for available feed and water with domestic livestock and wildlife.

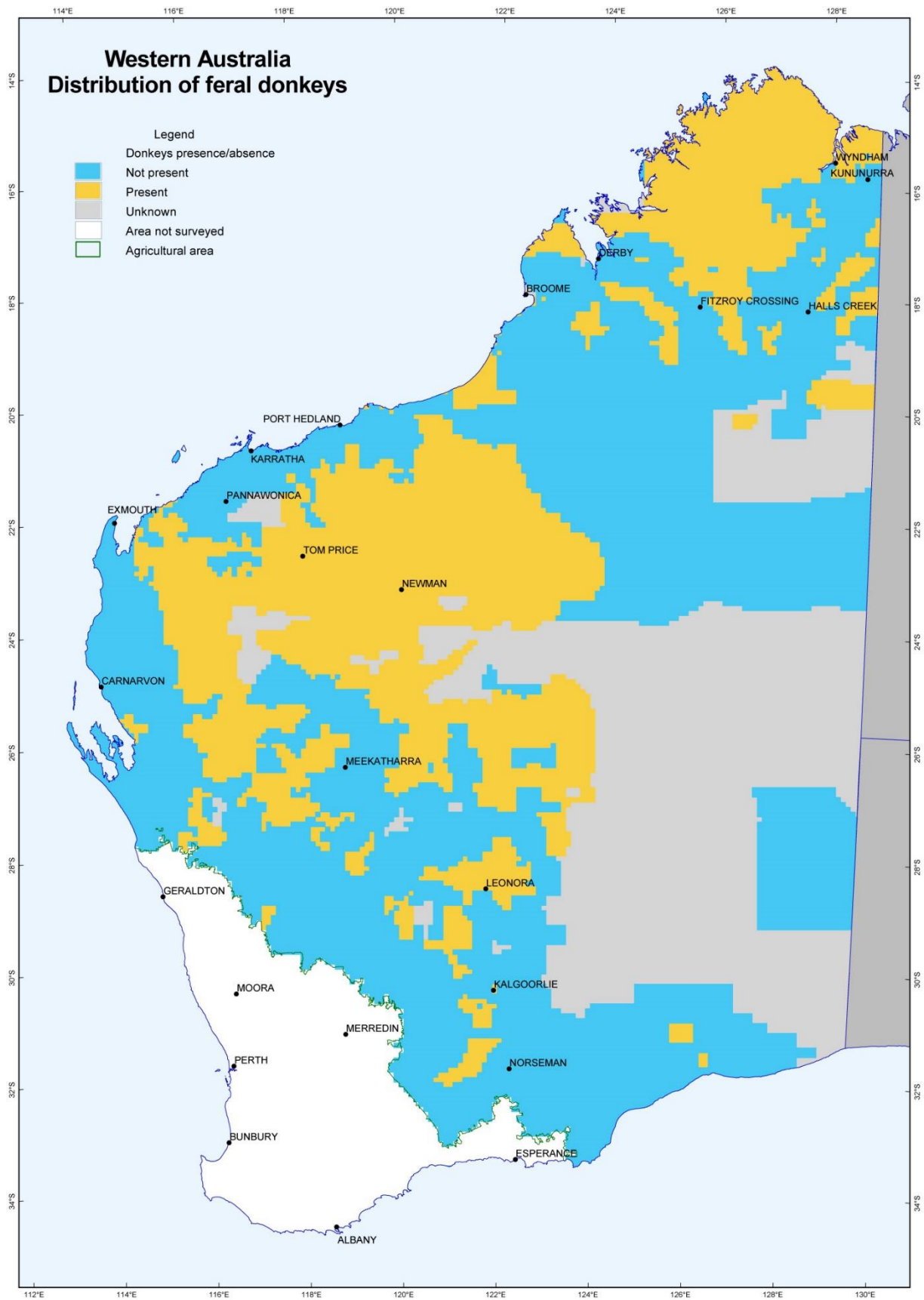


Figure 3. Distribution of feral donkeys in WA in 2017-2018<sup>2</sup>

<sup>2</sup> Data compiled by DPIRD from interviews with WA landholders and Annual Return of Livestock and Improvements in 2017-18; 'present' and 'not present' categories indicate landholder's perceptions.

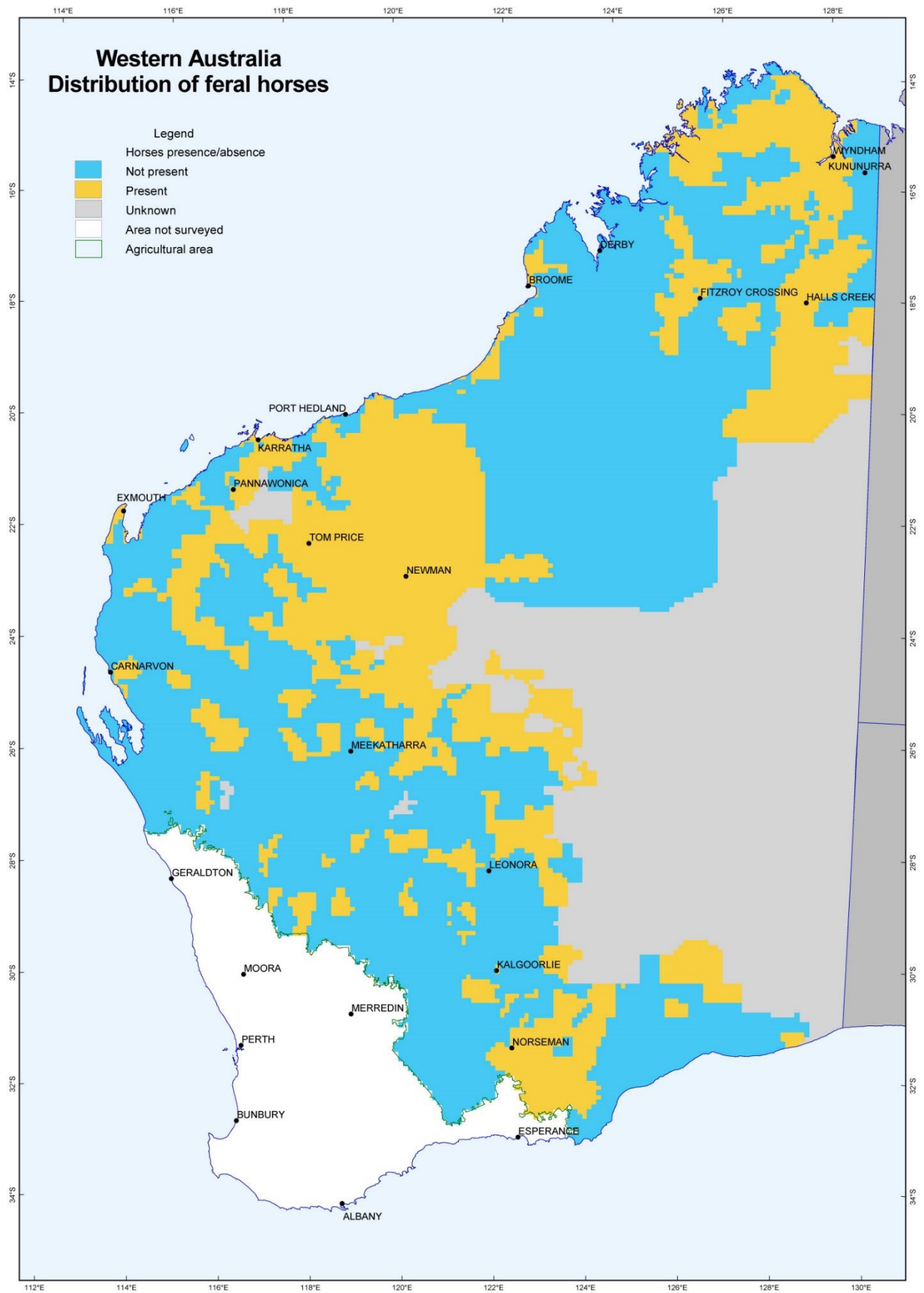


Figure 4. Distribution of feral horses in WA in 2017-2018<sup>2</sup>

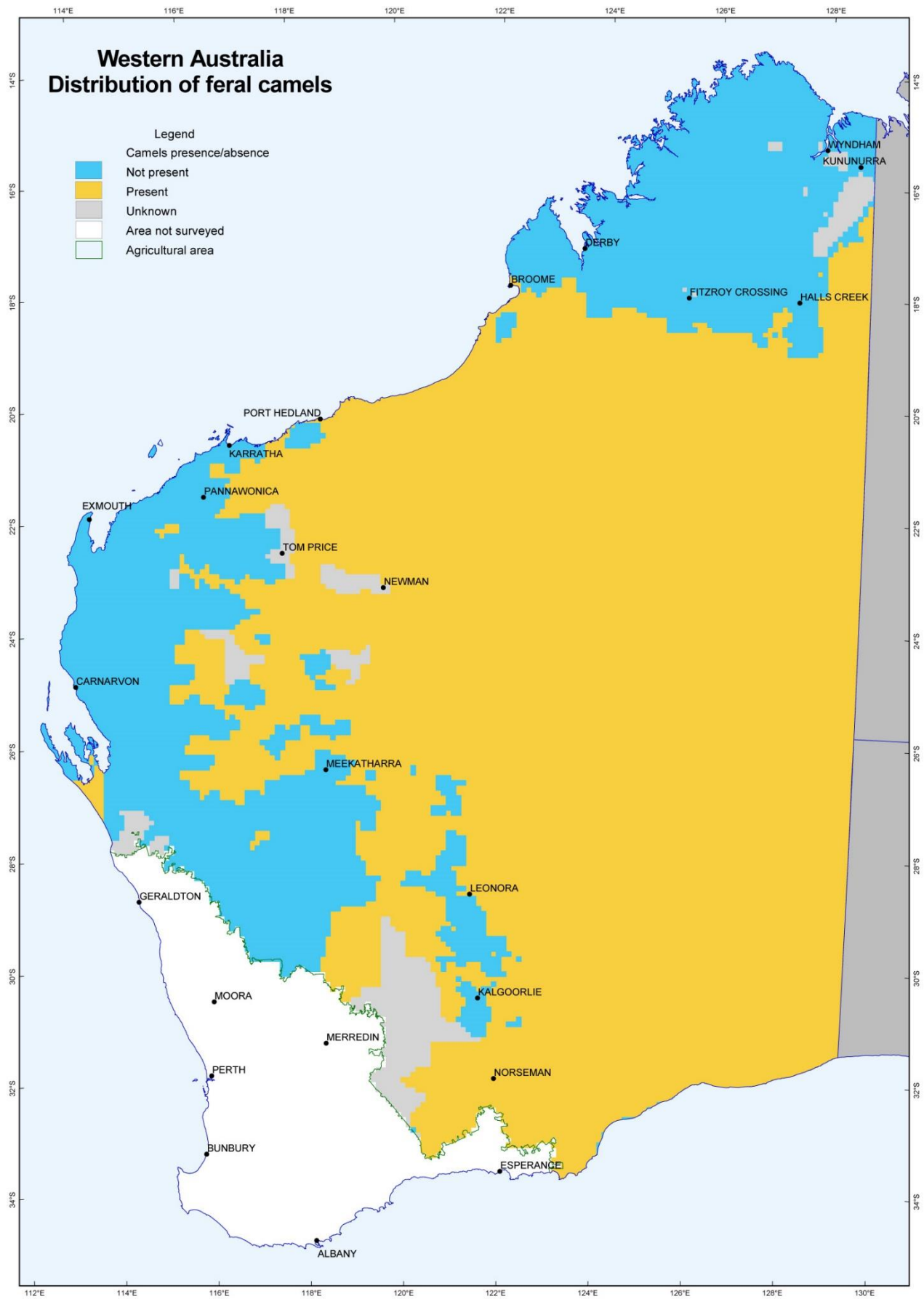


Figure 5. Distribution of feral camels in WA in 2017-2018<sup>2</sup>

## **LFH impacts**

LFH generate significant economic, environmental and social impacts.

### **Impact on the environment**

Feral donkeys, horses and camels have well documented adverse effects upon the native Australian environment (e.g. Bradshaw *et al.* 2007). Their large body size and congregational grazing behaviour have negative impacts on native grasses and shrubs that are intolerant to heavy grazing. In addition, LFH trample vegetation, changing its structure and composition as a result of soil compaction and erosion. They also damage watercourses through fouling and trampling, and compete with native animals for food and shelter. The ability of LFH to move through rough and remote country promotes the spread of weeds (Dobbie *et al.* 1993; DPAW 2017). These impacts interact with other threatening processes such as fire and depredation to further degrade the environment (Legge *et al.* 2019).

### **Impact on the economy**

The extent of the economic losses to industry due to LFH is difficult to quantify across WA rangelands. Feral donkeys and horses have negative impacts on pastoral industries through competition with domestic livestock for resources, disturbance of stock at watering points and interruption of cattle musters. The effect of feral donkeys and horses on pasture availability for cattle is pronounced during prolonged periods of drought (Dawson *et al.* 2006). Feral horses have similar nutritional requirements to cattle and therefore can compete directly for resources where the two species coexist (Dobbie *et al.* 1993). Feral camels also compete with livestock for pasture, but their most significant negative impacts are during droughts when they congregate around water points on properties with livestock and cause damage to pastoral and domestic infrastructure, such as fences, buildings and water troughs, bores and tanks (Edwards *et al.* 2008; Knight 2018). Water consumption by LFH during prolonged periods of drought can degrade the natural springs that supply fresh water for humans, livestock and native wildlife in remote areas.

### **Social and cultural impacts**

Social impacts of LFH are often overlooked. These include the negative impact on cultural (religious, burial, ceremonial) sites, and water points (rock-holes, soaks and springs), which are sacred and highly valued spiritually and culturally by Traditional Owners. Damaging impacts of LFH are considerable even at low population densities; trampling, grazing or pollution by the carcasses of perished animals may be significantly worsened in times of low rainfall or drought, when LFH concentrate around water sources. In remote communities, these species are known to cause nuisance in residential areas, and affect patterns of customary use of country by Traditional Owners (Edwards *et al.* 2008). LFH can pose a threat to human health and safety as they can cause motor vehicle accidents along remote roads. Reports of road accidents involving LFH, including fatalities, have increased in recent years across many regions in Australia (Dobbie *et al.* 1993; Dawson *et al.* 2006; Edwards *et al.* 2008).

### **Disease transmission**

Feral donkeys and horses are potential hosts for several exotic parasites and diseases including equine influenza, rabies, screw worm fly and vesicular stomatitis (Watson *et al.* 2011). Feral camels are susceptible to many of the exotic diseases of domestic ruminants, but the risk of camels spreading livestock diseases is limited by their remoteness from significant large domestic animal populations.



## Positive impacts

LFH are regarded by some landholders as having current or potential positive impacts. Some sections of the public have strong cultural connections with LFH, respect their heritage and feel empathy for them. Some Traditional Owners commercially harvest feral camels for their meat and skins and regard this as an important employment opportunity and source of income (Knight 2018). Others see feral camels as a future resource and are hopeful that the price of live animals, or their processed meat and hides, will increase sufficiently in the future to make a harvesting industry profitable (Edwards *et al.* 2008). In isolated cases, feral donkeys are seen by pastoralists as a valuable tool for managing vegetation to reduce the risk of fire in areas less accessible to domestic livestock, however this is based largely on anecdotal evidence.

These perceived positive impacts of LFH are viewed by the majority of landholders as being detrimental to the effective reduction of LFH numbers and for ongoing population management because they provide an incentive for some landholders to maintain the status quo of LFH populations. These populations may then act as a reservoir for re-infestation into other areas where proactive reduction programs are taking place.

## LFH management techniques in WA

Techniques used to manage LFH vary according to species distribution, population size, objective, skills and competency of operators, location, terrain and habitat type, extent of damage, season and climatic conditions, land tenure and available budget (Appendix 1). Management techniques should be sustainable, pose negligible risks to the operators, non-target animals or other assets, and uphold animal welfare considerations. Effective management of LFH should integrate a number of the listed methods and often requires coordination between many landholders and stakeholders.

### *Aerial culling*

The majority of LFH populations are located in remote areas with inaccessible terrain, making aerial culling the most practical and effective method of LFH control in WA. Aerial culling is a highly specialised operation undertaken from helicopters and using highly skilled government shooters. The *Firearms Act 1973* and *Firearms Regulations 1974* restrict the use of the semi-automatic firearms used in aerial culling in WA to a limited number of specially trained and licensed personnel from DPIRD and the Department of Biodiversity, Conservation and Attractions (DBCA). These personnel operate under the *Animal Welfare Act 2002* and comply with strict, audited animal welfare benchmarks (Sharp and Saunders 2011).

In areas with high animal populations, aerial control programs are able to effectively reduce population numbers where lack of vehicle access makes ground-based management impractical or impossible. Aerial culling of one herbivore species can be performed in conjunction with other species, and is regarded as the most practical and effective method of rapid removal at the landscape scale. However, the method is expensive to undertake, requires considerable forward planning, and is less cost-effective at low animal densities.

### *Telemetry control (use of Judas animals)*

The telemetry-Judas technique can be successfully used for the landscape-scale control of gregarious animals, such as LFH at lower densities, and those which are difficult to locate by other methods. The chosen 'Judas' animal is fitted with a radio-tracking collar and released to seek other animals in the area. The group can then be located by radio-tracking and the accompanying animals are removed. It is an expensive technique requiring skilled operators but is particularly useful at low animal densities if local eradication is the objective.

### *Ground culling*

Ground culling is effective for small numbers of animals and sometimes the only suitable method for removal of LFH. Ground culling is often combined with mustering and trapping for small-scale management, and is useful in assisting with follow-up management activities. The method is not suitable in remote and inaccessible terrain.

Appropriately licensed and skilled landholders in WA opportunistically remove LFH from their properties by ground culling, mustering, or passive trapping. Professional shooters in the pet meat trade primarily use ground culling to remove LFH. However, the low economic value of pet meat means it is only viable where LFH densities are high and carcasses can be transported economically to the processor.

Aerial or ground based culling is opposed by some Traditional Owners and some sections of the public who have religious, cultural and emotional connections to LFH, and who ascribe values to them in a variety of socio-cultural contexts, and who may also be opposed to the wastage of a potential food resource.

### *Ground and aerial mustering*

In contrast to aerial mustering, which is most useful in large areas that are rugged or inaccessible to ground-based vehicles, ground based mustering is most suitable for open and flat terrain. Animals are mustered into permanent or portable yards and either trucked live from the yards, or shot on site. Mustering can considerably reduce high densities of LFH, but is costly and requires a team of experienced personnel with appropriate vehicles and infrastructure.

### *Passive trapping*

LFH can be passively trapped using trap yards, built most commonly near water sources or on high use animal trails, usually equipped with feed or water as an attractant. Passive trapping requires good local knowledge of animal behaviour to determine the best location for trap construction. Animals passively enter the enclosure through trap gates and are either trucked live from the yards or shot on site. Passive trapping reduces the need for specialised personnel but can only be used to capture small groups of animals.

Both ground based mustering and passive trapping can valuably contribute to reducing LFH population numbers and help offset the cost of managing LFH if the live animals, meat or skins can be sold. However, neither method is viable at lower population densities, and each is likely to have only a small and localised impact on the LFH numbers in WA.

### *Exclusion fencing*

Fencing can be used to fence animals in, exclude them from high value areas, or prevent their movement into areas that have been depopulated by removal programs. Exclusion fencing is costly and requires ongoing monitoring and a high level of maintenance. Feral camels are particularly difficult to contain because of their size and ability to bulldoze through the types of fencing typically used to contain cattle, so exclusion fencing for camels is particularly expensive to construct. In general, fencing is not practical where LFH populations are large and dispersed across vast areas, but could be feasible for short-term and small-scale exclusions, or when the asset being protected is of particularly high value (e.g. rare flora or fauna, threatened ecological community, a significant tourist destination, or a particularly culturally sensitive site).

## Animal welfare

Animal welfare is a key consideration in effective LFH management. Humane, safe and effective control practices are very important. The Australian Animal Welfare Strategy was developed to guide the development of new, nationally consistent policies for the humane treatment of animals and enhance existing animal welfare arrangements.

Consistent with the Australian Animal Welfare Strategy, National Model Codes of Practice (COPs) for feral [donkeys](#), [horses](#) and [camels](#), [State Code of Practice for the Capture and Marketing of Feral Animals](#), and [Standard Operating Procedures \(SOPs\)](#) have been developed for the humane control of a range of pest animal species, including LFH, to assess relative humaneness of a range of control methods and to provide guidance on best practice.

## Key success factors for effective LFH management

- The key to effective LFH management lies in the long-term, sustained use of multiple, complementary humane control techniques across a range of scales and land tenures.
- Strong ownership and commitment from all stakeholders and a willingness to actively share knowledge and resources, to collaborate, and to coordinate management activities are critical to effectively manage LFH on a landscape scale.
- Partnerships between landholders (both private and government), industry, landholders, and not-for-profit organisations encourage identification and ownership of the problem, adoption of long-term planning, and facilitation of effective communication.
- Successful management requires all landholders to adopt approved control techniques and to apply these using the highest animal welfare standards.
- Management decisions should be based on evidence specific to local impacts and conditions.
- Management activities should have measurable outcome-based objectives that are clear, achievable, monitored and adaptive. Once the desired aims or benefits are achieved, steps should be taken to maintain the beneficial state.
- A better understanding of the economic, environmental and social impacts of LFH is required to enable informed decision-making and prioritisation of control activities on a cost-benefit basis. Improved understanding of LFH population size, density and distribution would enable evaluation of management programs.
- Best practice LFH management integrates a range of control techniques (including commercial use where appropriate), accounts for seasonal conditions (by taking advantage of animal congregations during drought), and animal welfare.
- A secure, ongoing funding stream is essential for effective LFH management in the long-term. For example, DPRs together with the dollar-for-dollar matching funding contributed by the State government support LFH control activities on the lands on which the DPRs are raised. However, these funds are also required to support the control of other declared pest species (both fauna and flora) and are therefore subject to local prioritisation.
- The ongoing support of the Western Australian public is essential to maintain the contribution of public funding to LFH management, and to maintain the social license to control these pest species.



## Goals and strategies

Table 1: Summary of Goals and supporting strategies<sup>3</sup>

Goal 1: LFH management is collaborative, coordinated and integrated	
<b>Strategy 1.1</b>	Facilitate collaboration between all stakeholders and enable sharing of knowledge, resources and skills
<b>Strategy 1.2</b>	Review and address, wherever possible, legislative, policy, social or cultural barriers that prevent a tenure-blind approach for LFH management
<b>Strategy 1.3</b>	Build the knowledge, capacity and commitment of all stakeholders to deliver a coordinated, regional scale and tenure-blind approach to LFH management
<b>Strategy 1.4</b>	Establish and support an advisory group with broad representation from key stakeholder groups to guide LFH management in WA
Goal 2: LFH management is innovative, effective and cost-efficient	
<b>Strategy 2.1</b>	Quantify the environmental, economic and social impacts of LFH in all regions to ensure transparent investment in LFH management that is prioritised by asset value, region and species
<b>Strategy 2.2</b>	Set location-specific targets for LFH control that are evidence-based, and recognise the practical limitations of current management techniques and available resources
<b>Strategy 2.3</b>	Establish and support monitoring programs of sufficient scale and intensity to improve evaluation of the effectiveness of LFH management activities
<b>Strategy 2.4</b>	Collaboratively develop, apply and evaluate innovative new management techniques
<b>Strategy 2.5</b>	Explore options to address State government policies and processes that restrict the ability of landholders, particularly RBGs, to undertake timely and cost-effective management activities
<b>Strategy 2.6</b>	Facilitate commercial harvesting of LFH where it complements but does not conflict with other integrated LFH management approaches
<b>Strategy 2.7</b>	Explore options to enable additional appropriately trained and licensed operators to undertake aerial control of LFH

<sup>3</sup> The Goals and Strategies have not been prioritised and the order in which they are listed does not imply priority.

**Goal 3: LFH management is adequately resourced and ongoing**

<b>Strategy 3.1</b>	Investigate ongoing and stable funding streams to support the administration and delivery of effective LFH management on government and privately owned or managed land
<b>Strategy 3.2</b>	Ensure that public funding directed to RBGs for LFH management can be accounted for and linked to strategic plans, while still retaining flexibility to undertake opportunistic or emergency management activities

**Goal 4: Reporting mechanisms support effective LFH management and facilitate stakeholder engagement**

<b>Strategy 4.1</b>	Develop and support an easy-to-use reporting system to ensure consistent processes for reporting and sharing information that support effective and coordinated LFH management
---------------------	--

**Goal 5: LFH management is undertaken to the highest animal welfare standards and complies with all relevant legislation**

<b>Strategy 5.1</b>	Ensure all stakeholders utilise best-practice LFH management techniques that comply with State and National animal welfare standards and legislation
<b>Strategy 5.2</b>	Review the role of compliance with biosecurity and animal welfare legislation in LFH programs

**Goal 6: The Western Australian public is supportive of LFH management**

<b>Strategy 6.1</b>	Raise public awareness of the current environmental, economic and social impacts as well as the projected future impacts of LFH if investment in management is not maintained
---------------------	---

**Goal 1: LFH management is collaborative, coordinated and integrated**

**Strategy 1.1: Facilitate collaboration between all stakeholders and enable sharing of knowledge, resources and skills**

Effective management of LFH requires strong ownership and commitment from all stakeholders and a willingness to actively collaborate. This approach would maximise the overall effects of control operations by reducing the need to remove large numbers of animals on a regular basis.

An integrated approach requires that stakeholders develop management plans with clearly identified and defined management objectives (what is to be achieved in terms of desired outcomes); options (eradication, containment, sustained management, targeted management, one-off action, and taking no action); strategies (selecting techniques to achieve management objectives); and evaluation to ensure the success of the program.

There are a number of stakeholders engaged in undertaking or regulating LFH management, including Traditional Owners, pastoralists, local, State and Australian government organisations, regional NRM bodies, licensed pest management technicians, mining companies, RBGs and other community based not-for-profit organisations. In addition, there are organisations and individuals that have an interest in LFH management or are indirectly affected by LFH, such as animal welfare organisations, tourism operators and the general public.

Mechanisms that facilitate collaboration between stakeholders and which enable open communication and the sharing of knowledge, resources and skills need to be supported where they exist and established where they do not currently exist. These mechanisms need to recognise and accommodate cultural differences and sensitivities, and varying capacity and capability of stakeholders.

In the pastoral regions, the RBGs play a pivotal role in delivering LFH management. However, the responsibility for the management of LFH across other large areas of the State, such as Indigenous Protected Areas, Exclusive Native Title Determinations, local or State government managed parks and reserves, unallocated crown land, unmanaged reserves and mining tenements, belong to those landholders (Figure 1). As a result, while the RBGs can implement a coordinated approach to LFH management across private landholder properties and pastoral leases, it is difficult for RBGs to influence management across all tenure within the RBG boundaries. This can result in a discord between RBG versus State government management programs, or in some cases, the lack of management programs. The adoption of a tenure-blind approach supported by neutral, region-specific leadership structures could remove such limitations.

**Strategy 1.2: Review and address, wherever possible, legislative, policy, social or cultural barriers that prevent a tenure-blind approach for LFH management**

The adoption of a tenure-blind approach is widely acknowledged as being essential to deliver efficient LFH management, however there are many legislative, jurisdictional and stakeholder relationship challenges that must be overcome before this can be achieved.

Complex land tenure and land management arrangements hinder the overall management of LFH, particularly feral camels, which are highly mobile and difficult to contain. Under current arrangements, it is difficult, time consuming and in some cases impossible to obtain permission to enter lands of different tenure to undertake activities including surveillance, animal detections, impact assessments, and control operations for LFH.

In the case of Traditional Owners, there may be cultural attachments to LFH, or they may be viewed as a valuable resource. Therefore, being able to understand these as well as other culturally sensitive issues is critical for successful and effective engagement.

State government agencies including DBCA, DPLH, the Department of Defence, Department of Water and Environment Regulation (DWER) and the Water Corporation (WaterCorp) are responsible for large areas of land where LFH are present. Each of these agencies operate under different legislation and policy frameworks which results in different LFH management strategies being implemented. To complicate the matter more, the way that legislation and policies are applied may vary from region to region within the same agency.

Similarly in the Pilbara and Goldfields regions, large areas of land are managed by mining companies where LFH are present. While LFH management occurs in pastoral leases owned by mining companies, management within mining tenements can be challenging as it requires a high level of approvals to meet mining OSH requirements.

The combined effort of all stakeholders is required to identify and resolve issues that prevent or hinder a tenure-blind approach to LFH management. Aligning policies and protocols within and across agencies would be beneficial in enabling a tenure-blind approach. Uniform standards and practices across State government agencies should be addressed through cooperative arrangements, formal policies, or MOUs.

**Strategy 1.3: Build the knowledge, capacity and commitment of all stakeholders to deliver a coordinated, regional scale and tenure-blind approach to LFH management**

Large feral herbivore management is a shared responsibility. The wide range of stakeholders involved necessitates that information and support be provided in different ways in order to increase stakeholder capacity and motivation to undertake effective management activities.

To enable this, the following are of particular importance:

- increasing awareness and understanding of LFH impacts
- building and sharing knowledge of available management options and approaches
- providing training in data acquisition, analysis and reporting, and mechanisms to share data
- providing information and training in best-practice management techniques
- enabling ready and timely access to appropriately skilled personnel and resources to undertake aerial control
- identifying and supporting neutral, region-specific leadership structures that facilitate stakeholder collaboration and cooperation.

To maximise effectiveness, commitment and coordination of management activities across the region by individual stakeholders is required. Integrated planning is a necessity in LFH management and therefore it is important that resources are allocated and work is undertaken at the appropriate state, regional and local level.

**Strategy 1.4: Establish and support an advisory group with broad representation from key stakeholder groups to guide LFH management in WA**

During the stakeholder consultation phase to develop the Western Australian Large Feral Herbivore Strategy 2020–2025, a wide range of stakeholders expressed a strong desire to have an active role in improving the way that LFH management is currently undertaken in WA.

To facilitate stakeholder participation and involvement, an advisory group with broad representation from key stakeholder groups should be established to guide LFH management in WA. This group should operate at a state level to provide overarching guidance to stakeholders in facilitating the implementation of the LFH Strategy at the regional and district scales.

## **Goal 2: LFH management is innovative, effective and cost-efficient**

### **Strategy 2.1: Quantify the environmental, economic and social impacts of LFH in all regions to ensure transparent investment in LFH management that is prioritised by asset value, region and species**

Despite considerable research being undertaken on some LFH species, relatively little is known about the environmental, economic and social impacts of LFH in WA. Factors such as LFH population size, distribution and movement patterns can significantly influence the efficiency and effectiveness of control activities. Quantifying impacts and obtaining good baseline data of population demography and dynamics should be a priority to ensure that LFH management activities are justified, strategic and evidence-based. This will result in greater accuracy in estimating the required funds. However, it is acknowledged that valuation of the natural environment and native species impacted by LFH is extremely difficult. As such, care should be taken to not under-value the benefits of LFH management in protecting natural environments.

### **Strategy 2.2: Set location-specific targets for LFH control, that are evidence-based, and recognise the practical limitations of current management techniques and available resources**

Location-specific targets for LFH densities are required to enable targeted investment in LFH management in priority areas and to enable the effectiveness of management activities to be evaluated against improvements in asset condition or LFH density targets. Determining location-specific targets will need to consider the following key factors:

- environmental, economic and social value of key assets
- current and projected environmental, economic and social impacts of LFH
- current and projected LFH population size and/or density
- available management techniques and the feasibility and cost of their application
- capacity of the responsible landholders to undertake the required management.

Management goals and priorities need to be determined, communicated to stakeholders, and then reflected in operational plans. Ultimately, goals for managing LFH will likely vary across the range of stakeholders as they will be dependent on a number of factors such as the region, type of primary production, landholder, conservation or cultural values, and the level of LFH infestation. However, while the goals may differ, the process used in determining them must be underpinned by science, have a risk-based approach, and consider the cost-effectiveness of obtaining the desired outcomes.

Clear identification of management goals (prevention of spread, eradication, sustained control, one-off control, or do nothing) allows managers to justify and defend actions. Targeted control in priority areas will provide better management outcomes (e.g. the reduction of LFH damage to threatened ecological communities, or to culturally sensitive assets such as waterholes, or to infrastructure) than applying limited resources and funding across large areas. Monitoring is crucial to support effective control approaches.

LFH are rarely uniformly spread across the landscape, therefore population densities and impacts can vary within regions and ecosystems. For this reason, management of widespread populations should focus on areas where impacts on assets under threat are greatest or where

the return for effort is greatest. For example, the management of feral camels may be most efficient if undertaken in the desert regions bordering the pastoral zone, before they enter the pastoral zone. Management programs should be focused at locations where jurisdictional and site characteristics (e.g. natural barriers to reinvasion, site accessibility and presence of cooperative landholders) provide a better chance of success.

While it is unlikely that total eradication of LFH from WA is achievable, local eradication within a defined area can be attained where LFH have not yet established, or populations are intensively managed. Local eradication should be considered where it is achievable, LFH pose a substantial risk to identified high priority areas, the cost of accomplishing eradication is acceptable and there is little risk of reinvasion.

**Strategy 2.3: Establish and support monitoring programs of sufficient scale and intensity to improve evaluation of the effectiveness of LFH management activities**

In the absence of sufficient data to determine LFH population size and densities in WA, the success of management is usually measured by the number of animals removed. Improved monitoring programs of sufficient scale and intensity are required to support the effectiveness of current LFH management activities. The establishment of monitoring programs will allow for the evaluation to be undertaken against known population distribution, sizes or densities, and improvements in environmental, economic and social parameters to be measured.

The structuring of monitoring programs should allow for sufficient data to be gathered by the stakeholder groups to ensure that the effectiveness of management activities can be evaluated systematically and with a high degree of confidence. Opportunities for other stakeholders such as Traditional Owners to contribute valuable but culturally sensitive observations and/or photographic evidence to map and document changes to the condition of key assets over time should be pursued.

**Strategy 2.4: Collaboratively develop, apply and evaluate innovative new management techniques**

Government and industry bodies should collaboratively undertake further research and field-testing of new approaches to manage LFH threats to different types of key assets and continue the development of innovative management tools that are effective, humane and cost effective. Simultaneously, current management methods should be constantly refined to improve best practice, and to customise best practice for different stakeholders, species and region.

**Strategy 2.5: Explore options to address State government policies and processes that restrict the ability of landholders, particularly RBGs, to undertake timely and cost-effective management activities**

State government agencies, particularly DPIRD, DPLH and DBCA, play an important role in LFH management through their regulatory role, control on lands they manage, and/or the services and resources they provide to stakeholder groups. However, there is scope for improving the alignment between State agencies' policies and procedures and simplifying procedures associated with LFH stakeholder groups in accessing resources, and reporting on activities.



The ability for stakeholders to obtain permission to enter lands of different land tenure in order to undertake management under current arrangements can be difficult and time consuming. For instance, RBGs must plan LFH control operations well in advance in order to satisfy the planning and operational procedures required by DBCA and DPIRD, which inhibits the ability for RBGs to respond to current needs and requirements. Furthermore, these agencies have different operating protocols, which can also delay and/or restrict the ability for stakeholders to obtain the appropriate approvals and be able to act quickly. The ability for stakeholders to respond and implement LFH management programs are further inhibited by limited numbers of approved aerial shooters, shoot controllers and/or helicopter operators.

State government agencies should seek to align and streamline policies and procedures related to LFH management for mutual benefit and to reduce administrative burden wherever possible.

**Strategy 2.6: Facilitate commercial harvesting of LFH where it complements but does not conflict with other integrated LFH management approaches**

Commercial harvesting offers landholders the potential to profit from LFH, which can be used to offset some portion of the cost of management activities and provide local employment, while reducing the LFH population. However, decisions about commercial harvesting of LFH need to be carefully considered, and if carried out, must be managed to ensure that it is humane and complements rather than conflicts with other approaches.

At present, commercial harvesting occurs on a small scale, therefore it is unlikely to significantly contribute to reducing LFH numbers or their negative impacts on a broader scale. This is because the effectiveness of harvesting LFH is affected by the location and population distribution, density, mobility and accessibility (roads). Different animals (both within and between species) can be utilised for varying purposes or products, and as a result, the cost recovery potentials vary. In order for commercial harvesting to become a significant control method for LFH, a comprehensive, sustainable and profitable market supply chain for each product would need to be developed.

There is potential for conflict between landowners, as some may wish to maintain a base population for commercial harvest, while others may be seeking intensive control. In order to minimise this potential conflict, careful management and cooperation between landowners is required to prevent ongoing re-infestation of surrounding properties that are intensively managing LFH. Landholders intending to utilise LFH for commercial or other purposes must adhere to appropriate animal keeping and identification requirements as set out in the BAM Act.

**Strategy 2.7: Explore options to enable additional appropriately trained and licensed operators to undertake aerial control of LFH**

The *Western Australian Firearms Act 1973* and *Firearms Regulations 1974* stringently restrict the use of Category D firearms. LFH are highly mobile and can disperse quickly, therefore aerial control is best undertaken using Category D firearms as these firearms have the ability to discharge multiple rounds rapidly. This is considered best practice, and their use is supported under state and national COP and SOPs. Non Category D firearms currently available for use by appropriately licensed landowners, contractors and others involved in LFH management are less effective for aerial control because of the greater delay between shots, and the need to reload more often.

Only appropriately trained and accredited government employees can use Category D firearms for LFH control purposes. DBCA and DPIRD are currently the state's only providers of aerial

control of LFH using Category D firearms. Therefore, as service providers, these agencies play a critical role in the management of LFH. Availability of qualified and authorised shooters, combined with a lack of adequate resourcing, can constrain effective LFH management. While restrictions on the use of Category D firearms apply in all other jurisdictions, in Queensland some Landcare groups employ accredited, private operators to undertake aerial control of LFH using Category D firearms.

It is essential for government agencies to have adequate resources including staff, funding, facilities and technologies to continue providing these critical services. In addition, feasibility of mechanisms to allow private operators to use appropriate firearms from aerial shooting platforms for the express purpose of LFH control should be explored.

### **Goal 3: LFH management is adequately resourced and ongoing**

#### **Strategy 3.1: Investigate ongoing and stable funding streams to support the administration and delivery of effective LFH management on government and privately owned or managed land**

Secure, long-term funding is needed to deliver effective LFH management on both government and privately owned or managed land. In the absence of ongoing and consistent management pressure, LFH are increasing considerably (Dobbie *et al.* 1993; Edwards *et al.* 2008). Except for isolated areas where local eradication is possible, management activities must be ongoing, even when population density is low.

Management of LFH is seen by most stakeholders to be significantly under resourced, with no secure long-term funding stream other than through the DPRs available to RBGs. These rates are applied to the management of all declared, widespread and established pest species located on pastoral leases and privately owned land. Currently, most funds in the rangelands are spent on wild dog management, which means there is less attention given to other priority pest species including LFH.

As many stakeholders are heavily reliant on national and state grants for LFH management, the extent, intensity and frequency of activities are often strongly influenced by funding availability. However, grant funding is sporadic, numerically target driven and limited in nature, and does not generally cover administrative costs, despite effective administration being essential to delivering coordinated and effective LFH control.

Opportunities to increase long-term funding for ongoing LFH management on privately owned land and pastoral leases should be actively pursued. This may include increasing the DPR where necessary (thereby also raising additional revenue through the dollar-for-dollar matching funding contributed by the State government), and seeking other opportunities (including Australian government funding or mining offsets) for LFH management purposes.

All levels of government (Australian, State and local) must seek to ensure that sufficient funding is available on an annual basis to effectively manage LFH. Of importance is the allocation of sufficient funding to adequately manage LFH on unallocated Crown land and on Indigenous managed lands, which can act as re-infestation reservoirs but where the capacity for management is limited.

Traditional Owners have a desire and responsibility to manage and protect their country for the long-term sustainable use of natural resources, and LFH have been recognised as a threat to the land's resources. These aspirations and responsibilities mean that many Traditional Owners want to be actively involved in the management of LFH on their traditional lands. While some



groups have capacity to manage LFH, other groups may require further resources, including capacity building in LFH management, to expand their efforts.

**Strategy 3.2:** Ensure that public funding directed to RBGs for LFH management can be accounted for and linked to strategic plans, while still retaining flexibility to undertake opportunistic or emergency management activities

Funding (contributed directly by government or through not-for-profit organisations) allocated to support LFH management is typically constrained. These constraints limit the flexibility of those accessing these funds to undertake emergency management activities, such as removal of LFH that concentrate around water sources during a local drought, or to mobilise quickly to control LFH that are damaging infrastructure, or a valuable natural asset.

Many stakeholders, including RBGs, rely heavily on grant funding to boost their capacity to undertake LFH management. However, grant funding is usually numerically target driven and directed at achieving specific conservation or biodiversity outcomes. Landholders seeking to access these grants may have to adjust the timing, location or nature of their planned management activities to fit within the grant guidelines, potentially compromising their ability to achieve optimum LFH control. Additionally, grants do not generally fund wages or administration costs, despite these being essential to any operation.

Public funding allocated to RBGs for LFH management should be transparently reported and accountably linked to strategic plans that have clearly articulated outcomes. If control activity cannot be undertaken, or would result in inefficient use of that money due to justifiable circumstances, RBGs are permitted to carry over unspent funding into subsequent financial years upon submitting a revised operational plan to DPIRD. The revision process and disbursement of funds should be undertaken within timeframes comparable with the revised programs, ensuring the RBGs' activities can be undertaken in a timely manner.

**Goal 4: Reporting mechanisms support effective LFH management and facilitate stakeholder engagement**

**Strategy 4.1:** Develop and support an easy-to-use reporting system to ensure consistent processes for reporting and sharing information that support effective and coordinated LFH management

A considerable amount of LFH data is currently collected in different ways by a range of stakeholder groups, including State government agencies, academic and not-for-profit conservation organisations, RBGs, Indigenous organisations, and others. The data ranges from scientifically rigorous to observational, anecdotal, and photographic records.

To ensure this data is collected in a consistent manner and can be accessed by relevant stakeholders, an easy-to-use and uniform reporting system that ensures consistent processes for data collection, reporting and sharing information is needed. The system would achieve greater consistency and efficiency in data collection, analysis and interpretation, and would allow for more effective coordination of management activities and decisions, enable rapid response, inform policy and facilitate information sharing.

Convenient and easy-to-use reporting tools, mechanisms and processes need to be readily available to stakeholders to ensure timely and effective response. Current reporting channels include phone, email, web applications, mobile apps (e.g. [FeralScan](#) (Invasive Animals CRC))

and informal reports through established networks. There is a need to promote and support uptake of existing platforms to enable transparency in data collection. As technology and user preferences change, continual review and evaluation is needed to ensure reporting mechanisms remain effective and appropriate.

Reporting mechanisms should provide reliable and consistent feedback to the user about actions taken. Feedback builds confidence and improves understanding, which in turn increases the likelihood of stakeholders utilising reporting mechanisms.

## **Goal 5: LFH management is undertaken to the highest animal welfare standards and complies with all relevant legislation**

### **Strategy 5.1: Ensure all stakeholders utilise best-practice LFH management techniques that comply with State and National animal welfare standards and legislation**

LFH management programs must comply with the *Animal Welfare Act 2002* (AW Act) and use the most humane, target specific, cost effective and efficacious techniques available to minimise animal suffering associated with management. Consideration of animal suffering must occur regardless of the status given to a particular pest species and the extent of the damage or impact caused by the pest.

Management of LFH needs to comply with the Code of Practice for the Capture and Marketing of Feral Animals in WA (2003) and it should adhere to the National Model COP and SOPs. While SOPs describe procedures involved with each control technique and address animal welfare issues applicable to each technique, the COP specifies aspects of current best practice principles and can provide a defence to the charge of cruelty under the AW Act. Relative humaneness is essential to take into account when selecting a control technique and is highly dependent on whether that technique is correctly employed (Appendix 1). In selecting techniques, it is important to consider whether sufficient resources are available to fully implement a chosen technique.

To maintain public and political support for LFH management into the future, it is critical that all stakeholders adhere to animal welfare standards and regulations. Best practice LFH management must be demonstrated to stakeholders by trusted sources in their local environment. Any innovations or improvements to control methods must be made available through the same channels.

### **Strategy 5.2: Review the role of compliance with biosecurity and animal welfare legislation in LFH programs**

The RBG model places expectations on the RBGs to determine the highest priority of declared pests (including LFH) within their boundaries and to work with all landholders to collaboratively manage them. This includes influencing those landholders who are seen to be non-compliant. Monitoring and enforcement is a key element of the regulatory framework and there is a risk that some landholders will not manage pests if there is no prospect of enforcement. However, RBGs have no capacity or statutory powers to enforce compliance, as this is the role of DPIRD as the administering State government agency.

State government agencies have finite resources to allocate staff to monitoring and compliance roles, with officers typically being responsible for large geographic areas and a broad suite of declared pests. These limited resources and the burden of evidence required to prosecute

cases of non-compliance means State government agencies prioritise their compliance actions. For the most critical issues, where enforcement can make the biggest impact, State government agencies may intervene; however, for less critical issues they prefer landholders to undertake voluntary compliance.

Review of the role of compliance in LFH programs should be undertaken to ensure that LFH management is compliant with animal welfare legislation, the BAM Act, and COP and that all landholders meet their responsibilities to humanely manage declared pests on their land. One option is to focus on awareness raising of landholder responsibilities and voluntary compliance coupled with a risk assessment to determine the role of compliance within the LFH program, and in relation to other priority declared pests within WA. This would align the role and level of compliance with the risk and outcomes desired for the WA invasive species program.

## **Goal 6: The Western Australian public is supportive of LFH management**

### **Strategy 6.1: Raise public awareness of the current environmental, economic and social impacts as well as the projected future impacts of LFH if investment in management is not maintained**

Public awareness of the detrimental impacts of and the consequent need to manage LFH is currently limited, however public support is required to maintain the social licence to manage LFH and ensure ongoing funding for LFH management.

It is important for the general public to be made more aware of the environmental, economic and social impacts of LFH and the need for humane management. However, culling animals is inherently unpleasant for many in the community, so the raising of public awareness should be undertaken carefully, in a coordinated manner, using simple but sensitive messaging. Public communications and messages need to be targeted, consistent, regionally specific, and relevant to the local issues.

The internet and increasingly widespread use of social media platforms has resulted in the ability to rapidly and widely disseminate information. It has also provided a ready platform for those wishing to spread misinformation, express extreme opinions or to sensationalise. As RBGs, DPIRD and DBCA are the lead organisations for LFH management in the rangelands, they should act together as the public face of LFH management. Moreover, they should actively collaborate with all stakeholders to ensure that a consistent approach and information sharing is taken by all when communicating LFH impacts and management. This has the potential to strengthen public support for LFH management.

## Implementation

Implementation of the LFH Strategy will be coordinated by DPIRD in consultation with the LFH advisory group.

No single group of stakeholders can meet the goals set out in this Strategy for managing LFH in WA. Stakeholders from different sectors with different roles and responsibilities should consider how they might best adopt the principles and goals, and work with others to maximise outcomes. Government agencies may need to work with non-government organisations to make the vision of this strategy a reality, and to ensure the gaps that have been identified are addressed. Action plans for each region and priority areas should be developed by the key stakeholders who are best placed to play an active role in LFH management.

The implementation plan will include a set of milestones that will be used to track the progress of LFH Strategy implementation, including:

- commitment from all stakeholders identified in this strategy to achieve collaborative and effective implementation, evaluation and review of the LFH Strategy
- establishment of a WA advisory group. Building on the success of the LFH stakeholder committee established voluntarily to help develop this strategy, an advisory group will be set up to oversee and coordinate the implementation of the LFH Strategy across the state and at regional levels
- prioritising and costing out goals listed in the LFH Strategy.

This Strategy guides LFH management over the next five years. The implementation of the Strategy will be reviewed periodically to ensure that it is working effectively. The Strategy will be reviewed after five years to assess adoption of the Strategy by all stakeholders and to identify and incorporate changes in LFH priorities in WA. Any necessary modifications to approaches will be made in consultation with the LFH advisory group.

## Appendix 1: Control techniques and considerations of LFH

Method	Application
<b>Aerial culling</b>	Most effective for removal of large numbers of animals occupying remote and inaccessible terrain. Aerial culling of one herbivore species is often performed in conjunction with other species. It is regarded as the most humane and cost-effective method for removing LFH at the landscape scale <sup>5,6</sup> . The overall welfare impact the method has on animals is moderate, with animal welfare risks including but not limited to fear from pursuit, wounding and period of pain and suffering, if not rendered immediately unconscious by the shot. The method is costly and less effective at low animal densities.
<b>Ground culling</b>	Effective for small numbers of animals and sometimes the only suitable method for removal of LFH. Often combined with mustering and trapping for small scale management, and useful in assisting with follow-up control activities. Method not suitable in inaccessible terrain. The overall welfare impact of this technique on animals is moderate, with animal welfare risks similar to aerial culling <sup>7</sup> .
<b>Telemetry ('Judas' technique)</b>	Successfully used for the landscape-scale control of gregarious animals, such as LFH, and those which are difficult to locate by other methods. Chosen 'Judas' animal is fitted with radio-tracking collar and released to seek other animals in the area. The group can then be located by radio-tracking and the accompanying animals are removed. It is an expensive technique requiring skilled operators but is particularly useful at low animal densities if local eradication is the objective of the operation. Telemetry control poses additional animal welfare risks to aerial culling alone, including stress of capture, restraint, and handling of the Judas animal.
<b>Ground and aerial mustering</b>	Ground mustering is most suitable for open and flat environments, while aerial mustering is useful in large areas, or where rugged and inaccessible terrain prevents access with ground-based vehicles. Animals are mustered into permanent or portable yards and are trucked live from the yards, or shot on site. Mustering can reduce high densities of LFH at small spatial scales. The method is not financially viable at lower animal densities or landscape-scale. Mustering causes stress and exhaustion in the mustered animals and has the potential to cause serious injury. Further potential welfare problems may arise when holding, handling and transporting animals from the yard to an abattoir. The overall welfare impact is mild to moderate, and is highly dependent on how the subsequent stages of holding and handling of animals are conducted <sup>7</sup> .

Method	Application
<b>Passive trapping</b>	The method requires good local knowledge of animal behaviour allowing the best location for trap construction. Traps are usually built near water sources, on high use animal trails, or when conditions are dry, and are equipped with feed or water as an attraction. Animals passively enter the enclosure through trap gates and are either trucked live from the yards or shot on site. The method reduces the need for specialised personnel, and can be cost effective if the animals are sold. It can only be used to capture small groups of animals and is very labour intensive. The overall welfare impact of passive trapping on target animals is moderate; however, welfare problems may arise during holding, handling and transporting captured animals <sup>7</sup> . The method can also have welfare impacts on non-target species.
<b>Exclusion fencing</b>	Electric or permanent fencing is usually constructed to fence animals in or to exclude them from high value areas and resources, or to prevent animal movement into areas that have been depopulated by removal programs. This method is very costly and requires ongoing monitoring and maintenance, as fences can be damaged by fire, flood and animals (particularly camels and cattle). In general, fencing is only practical for short-term and small-scale containment or exclusions. Fencing may pose animal welfare risks including but not limited to impeding access to feed and water, and fear, pain, and distress associated with entrapment and injury.
<b>Fertility control</b>	Immuno-contraceptive vaccines have been shown to successfully reduce or inhibit population growth only if used in small, contained and accessible animal populations. The method requires a high proportion (60-80%) of females to be treated to reduce population reproductive rates, gives no immediate reduction to the population size, and there is no long-lasting or permanent vaccine presently available. Consequently, the application of immuno-contraceptive vaccines that control fertility is not feasible for most rangeland conditions in Western Australia, where animal numbers are high, where animals are widely dispersed, or where the management objective is to eradicate or reduce the population to a sustainable level <sup>8</sup> . Animal welfare risks of fertility control include but are not limited to repeated pursuit, capture, restraint, and long-term functional and behavioural changes <sup>9</sup> .

<sup>5</sup> Hampton, J.O., Cowled, B.D., Perry, A.L., Miller, C.J., Jones, B., and Hart, Q. (2014). Quantitative analysis of animal-welfare outcomes in helicopter shooting: a case study with feral dromedary camels (*Camelus dromedarius*). *Wildlife Research*; 41, 127-135.

<sup>6</sup> Hampton, J.O., Edwards, G.P., Cowled, B.D., Forsyth, D.M., Hyndman, T.H., Perry, A.L., Miller, C.J., Adams, P.J. & Collins, T. (2017). Assessment of animal welfare for helicopter shooting of feral horses. *Wildlife Research*, 44, 97-105.

<sup>7</sup> Sharp, T., and Saunders, G. (2011). A model for assessing the relative humaneness of pest animal control methods (Second edition). Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT

<sup>8</sup> Hobbs and Hinds (2018). Could current fertility control methods be effective for landscape-scale management of populations of wild horses (*Equus caballus*) in Australia? *Wildlife Research*; 45, 195-207.

<sup>9</sup> Hampton, J.O. et al. (2015). Is wildlife fertility control always humane? *Animals*; 5,1047-1071.

## Appendix 2: Stakeholder roles and responsibilities in LFH management

Stakeholder	Role in LFH management
<b>Australian government</b>	
<b>Department of Agriculture and Water Resources</b>	<ul style="list-style-type: none"> <li>Administers the <i>Biosecurity Act 2015</i></li> <li>Undertakes national biosecurity risk analysis, import approvals, diagnostics, standards, policy, education and awareness</li> </ul>
<b>Department of Environment and Energy</b>	<ul style="list-style-type: none"> <li>Administers the <i>Environment Protection and Biodiversity Conservation Act 1999</i></li> </ul>
<b>State and local government</b>	
<b>Minister for Agriculture and Food</b>	<ul style="list-style-type: none"> <li>Under the BAM Act, may declare an organism as a declared pest for the whole or part of WA</li> <li>Recognises groups that are managing declared pests</li> <li>Determines Declared Pest Rates</li> <li>Allocates funds for invasive species management and surveillance, as authorised by the BAM Act</li> </ul>
<b>Minister for the Environment</b>	<ul style="list-style-type: none"> <li>If proclaimed, under the BC Act, may proclaim a species as an environmental pest for the whole or part of WA</li> <li>Allocates funds for environmental conservation</li> </ul>
<b>Department of Biodiversity, Conservation and Attractions</b>	<ul style="list-style-type: none"> <li>Undertakes surveillance and management of priority invasive species that affect environmental values on the State land that it manages</li> <li>Administers the BC Act and CALM Act</li> <li>Participates in tenure-blind control of invasive species with community groups</li> <li>Implements Good Neighbour Policy</li> </ul>
<b>Department of Planning, Lands and Heritage</b>	<ul style="list-style-type: none"> <li>Administers Crown land in WA</li> <li>Issues tenure and legal access to Crown land</li> </ul>



Stakeholder	Role in LFH management
<p><b>Department of Primary Industries and Regional Development</b></p>	<ul style="list-style-type: none"> <li>• Lead agency in developing the Western Australian Large Feral Herbivore Strategy 2020-2025</li> <li>• Provides strategic leadership in biosecurity matters across WA</li> <li>• Administers the <i>Animal Welfare Act 2002</i></li> <li>• Administers the BAM Act, including compliance and declaration process with the BAM Act</li> <li>• Leads the response to incursions and eradication of priority invasive species within the State, where it is feasible and cost-effective to do so</li> <li>• Provides inspection and certification services for interstate border and post-border movements, and at international borders (in collaboration with the Australian government)</li> <li>• Coordinates surveillance and reporting from industry and community, including biosecurity groups</li> <li>• Responsible for policies and systems that relate to specific pests</li> <li>• Undertakes research into the distribution, identification, surveillance, management and control of invasive species</li> <li>• Raises awareness, actively engages stakeholders and empowers them to share responsibility</li> <li>• Through the Director General, disburses funds from the declared pest account to RBGs for the implementation of operational plans</li> </ul>
<p><b>Department of Water and Environmental Regulation</b></p>	<ul style="list-style-type: none"> <li>• Administers the <i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i>, <i>Country Areas Water Supply Act 1947</i>, the <i>Water Services Act 2012</i>, and associated By-laws and Regulations</li> <li>• Responsible for protection of raw water quality in catchments</li> <li>• Responsible for the strategic management and protection of Public Drinking Water Source Areas</li> </ul>



Stakeholder	Role in LFH management
<b>Water Corporation</b>	<ul style="list-style-type: none"> <li>• Undertakes surveillance, on ground management and By-law enforcement of Public Drinking Water Source Areas under delegated authority from DWER, to protect the raw water quality in catchments</li> <li>• Participates in tenure-blind control of invasive species with State government agencies and community groups as appropriate</li> <li>• Raises awareness of the issues feral animals cause in the Public Drinking Water Source Areas</li> <li>• Provide observations and feedback as appropriate on large feral herbivore activity within Public Drinking Water Source Areas to DPIRD, DBCA, DWER, and the Department of Health</li> </ul>
<b>WA Police Force</b>	<ul style="list-style-type: none"> <li>• Administers the <i>Firearms Act 1973</i></li> <li>• Provides enforcement of the <i>Criminal Code Act 1913</i></li> </ul>
<b>Biosecurity Council of Western Australia</b>	<ul style="list-style-type: none"> <li>• Provides strategic advice to the Minister for Agriculture and Food, the Director General of DPIRD and other ministers on matters related to biosecurity</li> <li>• Comprises members with an interest and expertise in managing the biosecurity of WA</li> <li>• Actively engages with industry, community and government to ensure informed and robust advice is given</li> </ul>
<b>Biosecurity Senior Officer's Group</b>	<ul style="list-style-type: none"> <li>• Comprised primarily of senior executives from each of the WA State government agencies with statutory responsibility for the leadership and management of biosecurity in WA</li> <li>• Provides strategic overview and interagency coordination of biosecurity issues of interest to the State and the activities of member agencies</li> <li>• Raises awareness and provides advice on biosecurity issues to the Minister for Agriculture and Food and other ministers as required</li> </ul>
<b>Local government</b>	<ul style="list-style-type: none"> <li>• Raises awareness and undertakes surveillance activities within the community</li> <li>• Biosecurity responsibilities as landholders</li> </ul>

Stakeholder	Role in LFH management
<b>Industry</b>	
<b>Industry</b>	<ul style="list-style-type: none"> <li>• Undertakes targeted surveys and passive surveillance</li> <li>• Biosecurity responsibilities as landholders</li> <li>• Relevant primary producers contribute to management of priority pests through Industry Funding Schemes and Declared Pest Rates</li> <li>• Can participate in RBG programs and initiatives</li> <li>• Mining industry can contribute resources to some LFH control and biodiversity programs</li> </ul>
<b>Community</b>	
<b>Recognised Biosecurity Groups</b>	<ul style="list-style-type: none"> <li>• Established under the BAM Act for purposes including controlling declared pests that are important in local and regional areas relevant to the group</li> <li>• Develop operational plans to manage declared pests</li> <li>• Work in partnership with landholders, other RBGs and government agencies to develop and undertake strategic, landscape-wide management programs for declared species</li> </ul>
<b>Licensed Pest Management Technicians</b>	<ul style="list-style-type: none"> <li>• Undertake declared pest management activities</li> <li>• Service providers provide pest control advice to landholders</li> </ul>
<b>Landholders, managers and occupiers of land and freshwater bodies</b>	<ul style="list-style-type: none"> <li>• Primary responsibility for controlling invasive species on the lands they manage (legally obligated to control declared species)</li> </ul>
<b>Regional NRM bodies</b>	<ul style="list-style-type: none"> <li>• Overarching regional support and facilitation of both State and Australian government NRM objectives, including landcare, regenerative agriculture and biodiversity conservation</li> <li>• Supportive of community-led, locally driven solutions to regional agricultural and landscape function issues</li> </ul>
<b>Not-for-profit and community organisations</b>	<ul style="list-style-type: none"> <li>• Deliver on-ground programs, fundraising, communications and awareness-raising activities</li> <li>• Be aware and informed of invasive species and the importance of surveillance, and maintain vigilance</li> </ul>
<b>Research organisations such as CSIRO and universities</b>	<ul style="list-style-type: none"> <li>• Undertakes research and enters into partnership with other organisations to deliver on-ground programs</li> </ul>
<b>General public</b>	<ul style="list-style-type: none"> <li>• Report vertebrate pests</li> <li>• Be aware and informed of invasive species and the importance of their management</li> </ul>

## References

- Bradshaw, C.J., Field, I.C., Bowman, D.M., Haynes, C., and Brook, B.W. (2007). Current and future threats from non-indigenous animal species in northern Australia: a spotlight on World Heritage Area Kakadu National Park. *Wildlife Research*, 34, 419-436.
- Dawson, M.J., Lane, C., and Saunders, G. (2006). Proceedings of the National Feral Horse Management Workshop, Invasive Animals Cooperative Research Centre, University of Canberra, Canberra.
- Department of Parks and Wildlife [DPAW] (2017). Pilbara Conservation Strategy.
- Dobbie, W.R., Berman, D.M., and Braysher, M.L. (1993). Managing vertebral pests: feral horses. Australian Government Publishing Service, Canberra.
- Edwards, G.P., Zeng, B., Saalfeld, W.K., Vaarzon-Morel, P, and McGregor, M. Eds. (2008). Managing the impacts of feral camels in Australia: a new way of doing business. DKCRC Report 47. Desert Knowledge Cooperative Research Centre, Alice Springs.
- Invasive Plants and Animals Committee (2016). Australian Pest Animal Strategy 2017 to 2027. Australian Government Department of Agriculture and Water Resources, Canberra.
- Knight, A. (2018). Commercial management of the feral camels on aboriginal land in Central Australia. In: Advances in conservation through sustainable use of wildlife. Eds. G. Baxter, N. Finch, and P. Murray, University of Queensland, Gatton.
- Legge, S., Smith, J.G., James, A., Tuft, K.D., Webb, T., and Woinarski, J.C. (2019). Interactions among threats affect conservation management outcomes: Livestock grazing removes the benefits of fire management for small mammals in Australian tropical savannas. *Conservation Science and Practice*, 1, e52.
- Lethbridge, M., Saalfeld, K.W., and Edwards, G. (2016). Measured reductions in the density of camels under the Australian Feral Camel Management Project. *The Rangeland Journal*, 38, 173-179.
- Sharp, T., and Saunders, G. (2011). A model for assessing the relative humaneness of pest animal control methods (Second edition). Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.
- Watson, J., Daniels, P., Kirkland, P., Carroll, A., and Jeggo, M. (2011). The 2007 outbreak of equine influenza in Australia: lessons learned for international trade in horses. *Revue scientifique et technique (International Office of Epizootics)* 30, 87-93.
- Woolnough, A.P., Gray, G.S., Lowe, T.J., Kirkpatrick, W.E., Rose, K., and Martin, G. (2005). Distribution and abundance of pest animals in Western Australia: a survey of institutional knowledge. Department of Agriculture, WA, 203pp.
- Zabek, M.A, Pacioni, C., Ramsey, D., Everett, M., Sheehan, J., Watkins, R., and Kennedy, M.S. (2018). Feral donkey management in Western Australia: Have we made real progress? Australasian Wildlife Management Society Conference, Hobart, Australia.